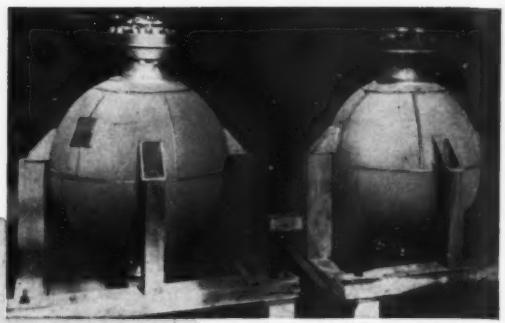
TECHNOLOGY DEPT

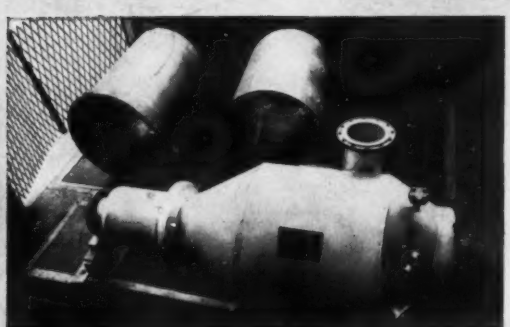
TECHNOLOGY REVIEW

July 1950

not just another TANK!



These 42" diameter 304 stainless steel spheres are for the storage of monomer chemicals, with an operating temperature of minus 58° F. and a pressure of 500 psig. The welding of the 12 spherical segments to form each tank was performed in compliance with Paragraphs U-69 and U-140 of the A.S.M.E. Code.



A vertical flash evaporator body—12' in height, 54" and 24" in diameter, built of $\frac{1}{4}$" thick type 316 extra low-carbon stainless steel. Use of expansion joint simplified a difficult space problem on the circulating pump piping.

A horizontal esterification kettle — 34' in length by 10' 9" in diameter, built of $\frac{3}{8}$" thick deoxidized copper, using the silver brazing process. The vessel was tested at 10 psig. and the steam chest at 250 psig. Total weight was 36,000 lbs.

Present-day equipment design of chemical process vessels frequently requires something more than just another tank. Vulcan handles many such design and fabrication problems and is providing numerous special purpose vessels to process users. Three recent examples are illustrated.

Items such as flash coolers, reactors, decanters, percolators and separators are constructed. Often storage drums and tanks require special features. Complete evaporation units, single or multiple effect, natural or forced circulation, are built. The individual items — bodies, calandrias, heat belts — also are available. Comparison on cost can be made between any of the metals — solid, clad or lined — through Vulcan's wide range of experience in alloy as well as copper and steel fabrication. Acetic acid, ethylene glycol, isopropanol, fatty acids and pharmaceuticals are typical products being handled in Vulcan-built equipment.

VULCAN { **distillation**
evaporation
extraction
processes and equipment

PILOT PLANT
PROCESS DESIGN
MECHANICAL DESIGN
SHOP FABRICATION
FIELD ERECTION
INITIAL OPERATION

THE VULCAN COPPER & SUPPLY CO., General Offices and Plant, CINCINNATI, OHIO

SAN FRANCISCO NEW YORK PHILADELPHIA BUENOS AIRES
IN CANADA—VICKERS VULCAN PROCESS ENGINEERING COMPANY LTD.—MONTREAL

Photo courtesy of United States Steel Corp.

NORTON WORKER BILL SKARIN, left, could give his 7-year-old son Paul some exciting information if they were to visit a steel mill. Bill knows industry. He has been with Norton 14 years. In fact, more than half of his fellow workers have been with Norton more than 10 years.

"IS HE CRACKING THE WHIP, DAD?"

"Yes, Paul, in a sense. He's whipping red hot steel into a pass in a 12-inch mill. That's called stranding. Now let's see how Dad's work helps steel men."

"HE'S GRINDING A BAR, or billet, by using Norton grinding wheels made of Norton's fast, cool-cutting 57 Alundum abrasive. With wheels like these, stock removal of 35 pounds per hour is not unusual.

"THEY'RE POURING METAL from an electric furnace that makes special alloys used in jet engines and rockets. Here again, Norton is on the job. The furnace is lined with a Norton high-temperature *refractory cement!*

"YOU SEE, PAUL, Norton is the world's largest manufacturer of abrasives and related products. In the metal working industry, as well as many, many others, you'll find Norton products always on the job."

Grinding wheel distributors in over 300 cities of the world; warehouses in five cities of the United States; branch grinding wheel plants in six foreign countries.

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BEHR-MANNING, TROY, N. Y. IS A DIVISION OF NORTON COMPANY

THE TECHNOLOGY REVIEW, July, 1950. Newsstand Edition. Vol. LII, No. 9. Published monthly from November to July inclusive at Emmett Street, Bristol, Conn. Publication date: twenty-seventh of the month preceding date of issue. Annual subscription $3.50; Canadian and Foreign subscription, $4.00. Entered as second-class matter at the Post Office at Bristol, Conn., under the Act of March 3, 1879.

in construction

these men are at home 'round the world

The Lummus construction superintendent and field engineer averages a twelve-year record of refinery building, literally—"everywhere under the sun." In addition, he has seen service at chemical plants and other heavy construction both in this country and abroad.

In a period of rapid progress, he has contributed to new techniques: the pre-assembly of pipe and equipment before erection, the raising of heavy vessels to greater heights and the providing of means to facilitate future maintenance and "turn around." Refinements in the scheduling of the erecting sequence are an outgrowth of his experience.

Behind Lummus' "ahead of time" deliveries stands the Construction Man. Because he has learned to *anticipate* the problems of remote location, emergencies seldom arise. But the records show that his decisions, made on-the-spot to meet the unexpected, reveal sound judgement and a steady hand. The low labor turnover, reflecting the high morale of his crews, both American and native, is evidence of his human as well as his technical understanding.

During the war he constructed, in record-breaking time, ordnance plants, high octane gasoline plants and plants that produced the raw materials for synthetic rubber. Today, the Lummus Construction Man is combining *time savings* with *dollar savings* in new projects throughout the world.

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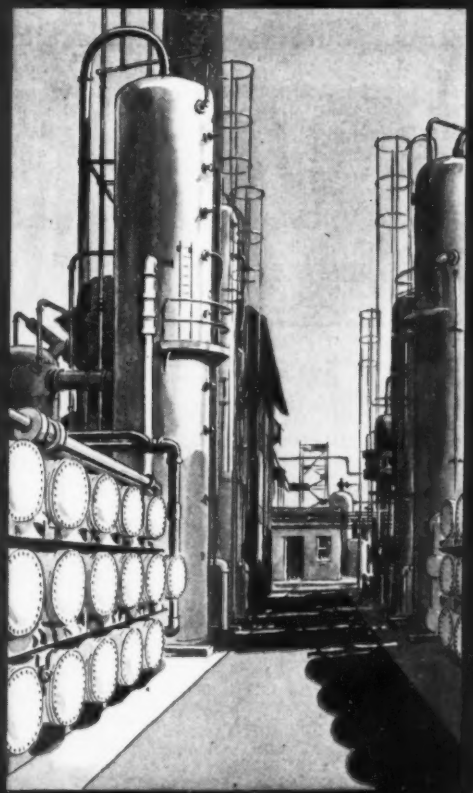

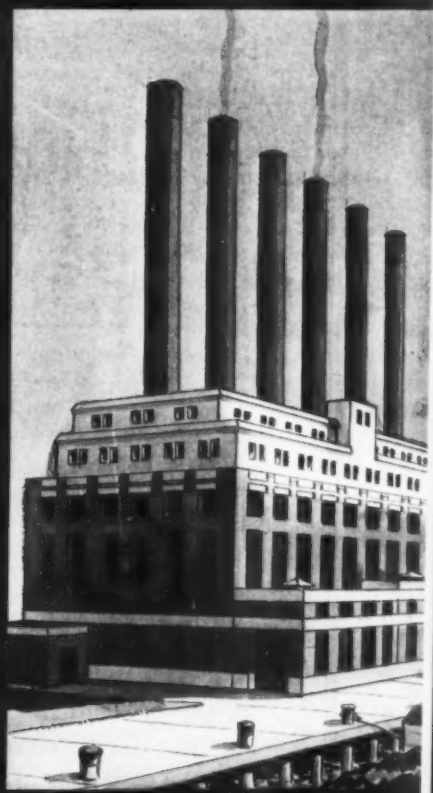

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JOY also builds the most modern line of portable and stationary compressors available for general industrial, mining, quarrying, and construction needs.

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Among the JOY executive personnel, we are proud to number the following men who are graduates of the Massachusetts Institute of Technology

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Vice Pres.-General Manager
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Vice President
Ventilating Equipment
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George Walter BERGMAN '27
District Manager
Knoxville, Tenn.

Robert Wesley SCOTT '23
Production Manager
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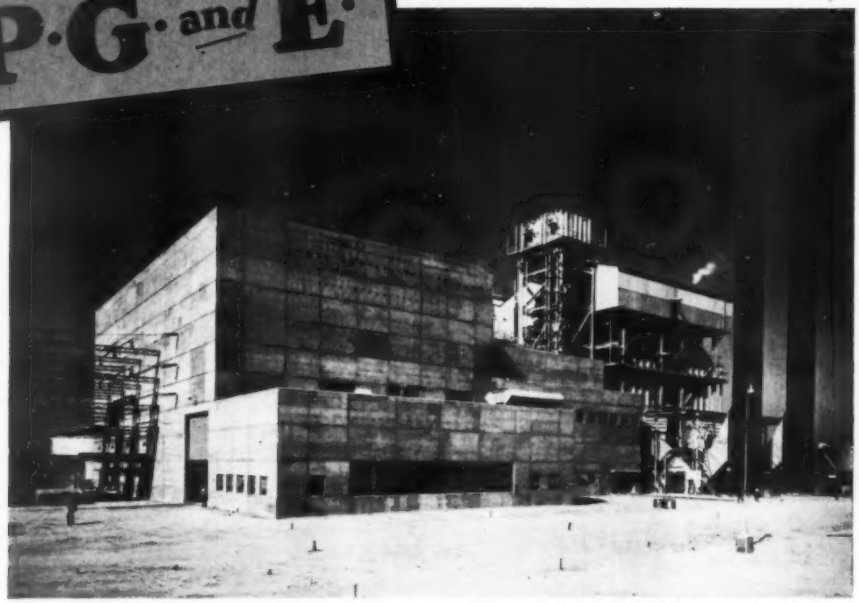
Michigan City, Indiana

Benjamin Philbrick LANE '23
District Sales Manager
Chicago, Ill.

Jonathan A. NOYES, '12
District Manager
Dallas, Tex.

FOR P·G·and E·



The Kern Steam Plant and the extension to Station P of the Pacific Gas and Electric Company represent the finest examples in the country of centralized control in steam power stations.

The Kern Steam Plant, with an installed rated capacity of 175,000 kw, recently completed for the Pacific Gas and Electric Company in Kern County, about 300 miles south of San Francisco in the San Joaquin Valley.

The extension to Station P, with an installed rated capacity of 222,000 kw, designed and constructed by Stone & Webster Engineering Corporation for the Pacific Gas and Electric Company at Hunters Point, San Francisco.

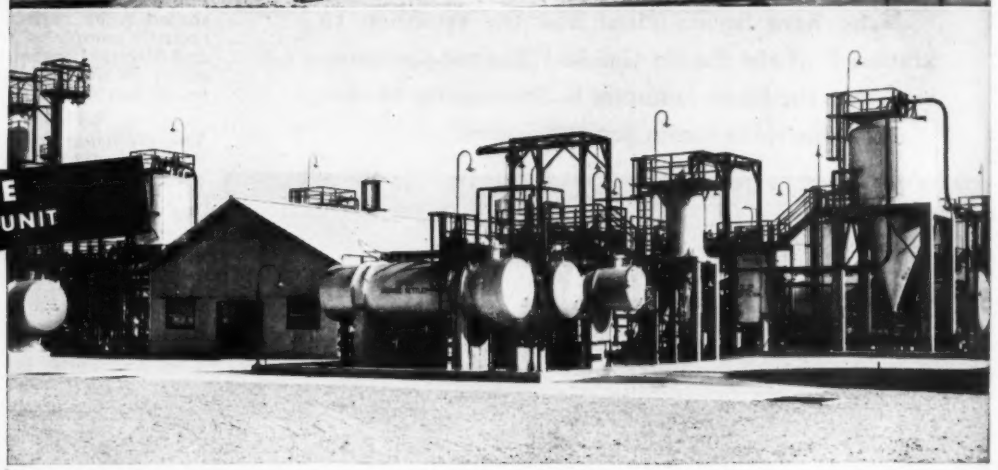
STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY OF STONE & WEBSTER, INC.

Construction by GRAVER

for THE TEXAS COMPANY Eagle Point Works

FURFURAL UNIT



LINDE TREATING UNIT

Again it's *construction by Graver* . . . this time, The Texas Company's first large east coast refinery—the multi-million dollar Eagle Point Works at Westville, New Jersey.

The Furfural Unit is a special design developed by The Texas Company and erected by the Graver Construction Co. This unit efficiently removes sulphur from middle distillates which are processed into diesel fuel and heating oil. The Linde Treating Unit was designed and erected by Graver from a flow sheet.

Other Graver construction included five cooling tower basins and pump houses, propane control house, B.S.W. pump house, river pump house, barometric oil separator basin and such miscellaneous jobs as foundations, pipe supports, sewers, manholes, and the handling of all material.

For further information and details . . . get in touch with Graver today. *When it comes to construction . . . come to Graver!*

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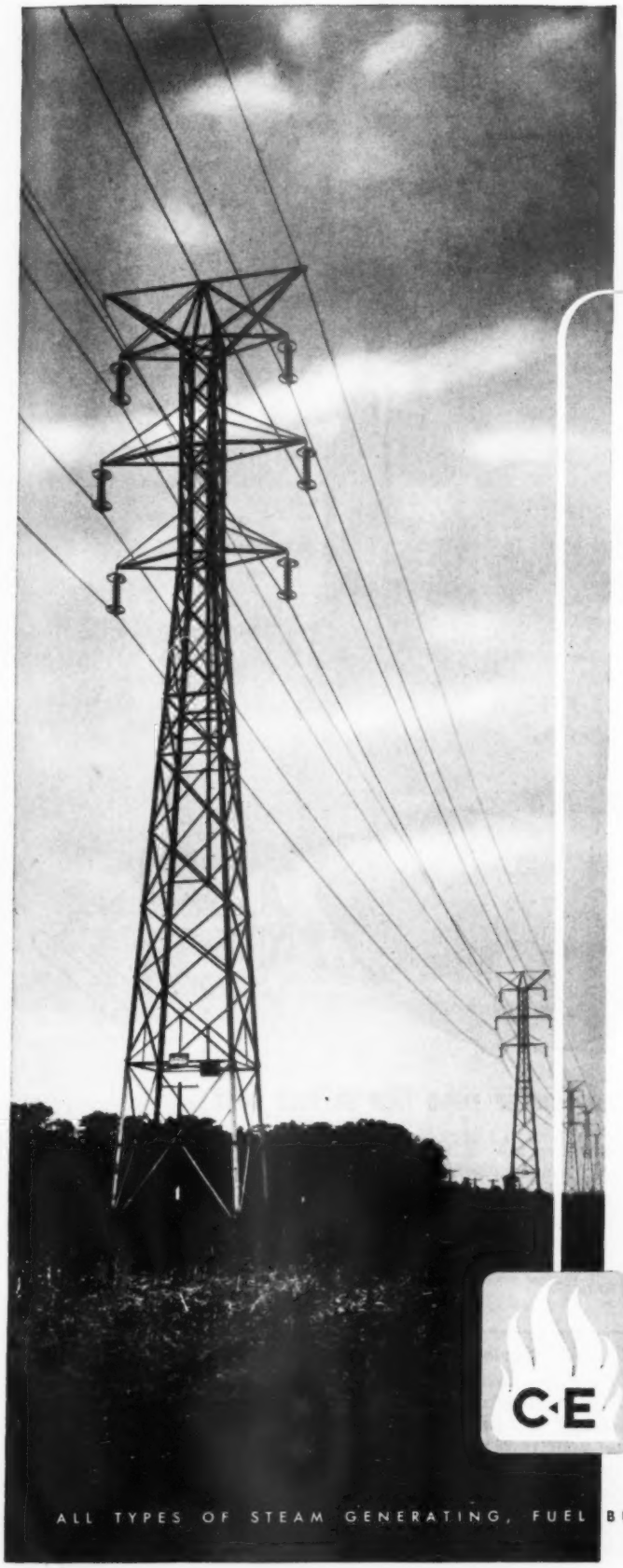

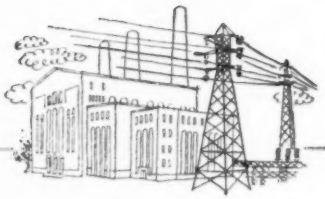

HOW *Kilowatt Highways* REDUCE YOUR STEAM PRODUCTION COSTS

Most of the power that pulses along America's kilowatt highways is produced by low cost steam. Keeping down steam costs . . . through improved boiler design and fuel burning techniques . . . is vital to electric utility companies. These steam economies are available to you, thanks to power station developments in steam generation that are translated into every Combustion boiler — industrial as well as utility.

For over a quarter of a century Combustion Engineering-Superheater, Inc. has originated, or been closely identified with *every* major development in steam generation for electric utility stations. With such a background of experience it is small wonder that Combustion *industrial* boilers reflect the operating economies of large central power stations. The importance of these economies is readily seen when you consider that the cost of *fuel alone* to operate a boiler for a *single year* is usually greater than the first cost of the boiler.

Plants in all types of industry have found that savings in operation, gained through Combustion's *applied experience* pay dividends year after year. This extensive experience — *focused on your need* — is freely available. Make use of it. A letter stating your problem will receive our immediate attention. B-402

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ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT

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"Rope engineering! What's that to me?"

. . . it's your assurance of longer rope life at less cost

Engineering is as important to rope as to any other mechanical tool you buy. You get it at no extra cost when you specify Plymouth ropes. Plymouth engineering is the skills, backed by research, that consider every factor before a Plymouth rope is made . . . its tensile strength, hardness, twist of yarn and strand, type of fiber, treatment. And instead of costing you money, it *saves* through longer rope life and fewer replacement costs. Here's evidence:

Plymouth periodically tests all brands of rope. Recent tests—based on tensile strength, and giving other brands the benefit of an assumed rate of deterioration equal to SHIP BRAND—show that when the average life of ten other brands was 4.8 months, then the life of PLYMOUTH SHIP BRAND was 6 months!

On that basis, you would have to buy rope at 9¢ less per pound before you could approach SHIP BRAND's low cost per month *to use!*

Prove Plymouth Savings Yourself
Send for unique cost-of-service chart. With it you can quickly figure what it is actually costing you *to use* your present rope, and how much you could save by using Plymouth.

SEE AND HEAR "THE PLYMOUTH STORY". *If you have not yet seen this color, sound film, write for an early showing. It shows how much more Plymouth puts into its ropes, so that the user may get more out of them.*

PLYMOUTH CORDAGE COMPANY
Plymouth, Massachusetts

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THE ROPE YOU CAN TRUST BECAUSE IT IS ENGINEERED FOR YOUR JOB

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Features the sensational new 16″ *rectangular* "black-face" tube — 139 square-inch screen with no "lost corners." Built-in antenna.

12½″ Console

Ninety-two square-inch picture plus a 10″ high-fidelity speaker in a rich-grained mahogany veneer cabinet. Built-in antenna.

16″ Table Model

New 16″ *rectangular* "black-face" screen (139 square inches) lets you see the whole picture exactly as transmitted — no lost corners. Built-in antenna.

12½″ Table Model

Ninety-two square-inch screen and twin "binaural" speakers for unsurpassed FM tonal fidelity in a table model. Built-in antenna.

NATIONAL TELEVISION is winning new laurels for the engineers of the National Company whose technical skill and knowledge have made National electronic products famous throughout the world — for outstanding performance and unfailing dependability.

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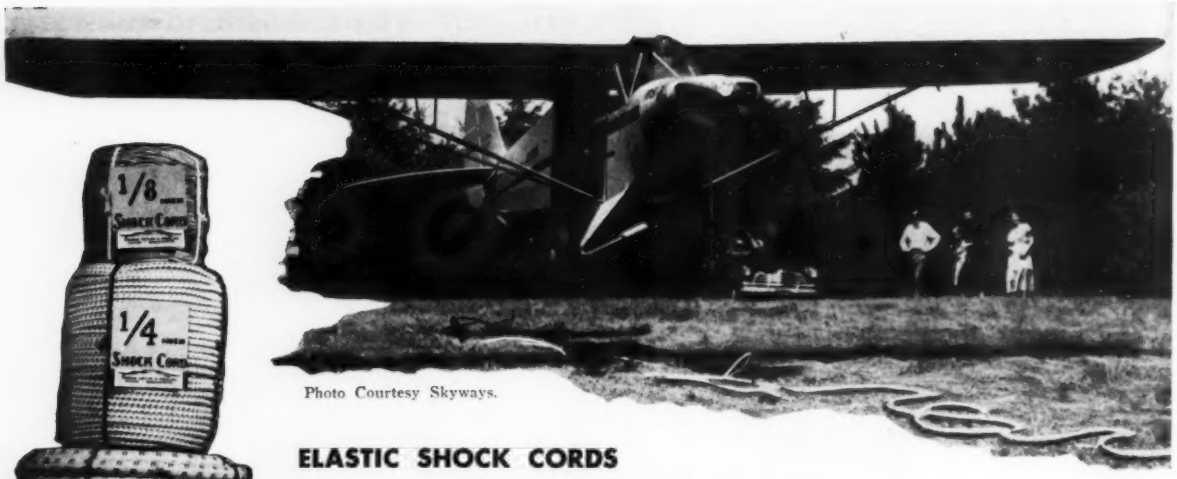

Photo Courtesy Skyways.

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enable a small-plane owner to take off in a small "backyard airport." By using this "slingshot" method a pilot can take off in as little as 3 plane-lengths. Ask us for details.

We supply the aircraft industry with elastic shock cord, and elastic exerciser cord produced in various sizes to meet the military specifications of the U.S. government.

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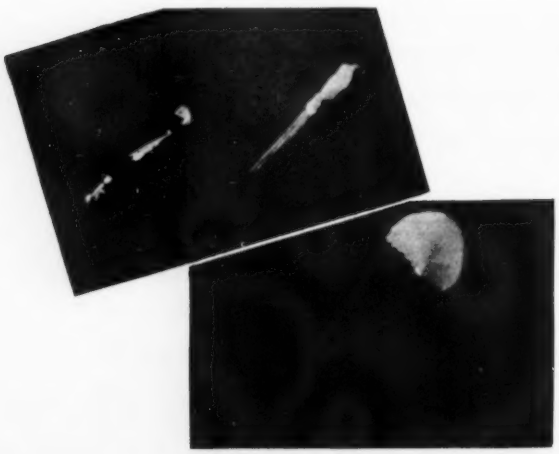
Developed by Robert Taylor Dawes (M.I.T. 1926) this elastic shroud line quickly takes up the shock of the opening parachute, even though the paratrooper bails out from a plane going at high speed. Landing shock and oscillation are markedly reduced, and a chute shrouded with these elastic lines spills its air automatically, minimizing the drag along the ground. It affords fliers greater safety in emergency jumps, and increases their efficiency.



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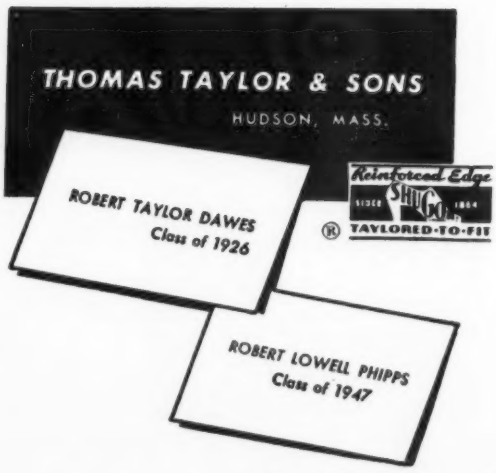
BETTER THAN RAWHIDE *Laces*

Dawhide "better than rawhide" Laces are tough, long-wearing, non-slipping, fabric laces that have been chemically treated and scientifically impregnated to become water-resistant and non-freezing. Dawhide Laces are ideal for active sport and rugged work shoes, and were used on the Byrd Expedition II to the Antarctic for lacing boots and lash ropes for pack sleds, tents, etc. Dawhide Laces were invented by and named for Robert Taylor Dawes, M.I.T. 1926.



four major advances in solderless wiring

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AUTO-CRIMP* terminals provide up to 3300 excellent terminations per hour when used in AMP AUTOMATIC MACHINES.
SOLISTRAND* terminals for solid or stranded wire.
CORROSION PROOFING special process protects terminals from acids, salt spray and noxious fumes.

As part of a continuing campaign for technical improvement in Solderless Wiring, Aircraft-Marine Products Inc. has frequently called upon M.I.T.'s laboratory and research facilities for exhaustive test data.

Work done here has played an important part in designing and adapting AMP terminals for specialized uses, especially in the aircraft and electronics industries. Noise level studies in amplified circuits as well as work with methods of CORROSION PROOFING are outstanding examples.

As a result, technical data is now available on a wide variety of subjects relating to solderless terminals and their performance.

Shown here are but four of the major achievements contributed by AMP toward a better and more economical means of wire termination.

F. H. Wells	*'18*
U. A. Whitaker	*'23*
J. R. Vickery	*'35*
Quentin Berg	*'37*

AMP

*Trade Mark

Items shown are protected by U. S. Patent Nos. 2,379,567; 2,405,111; 2,410,321; 2,468,169 and U. S. Patents Pending.

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THE TABULAR VIEW

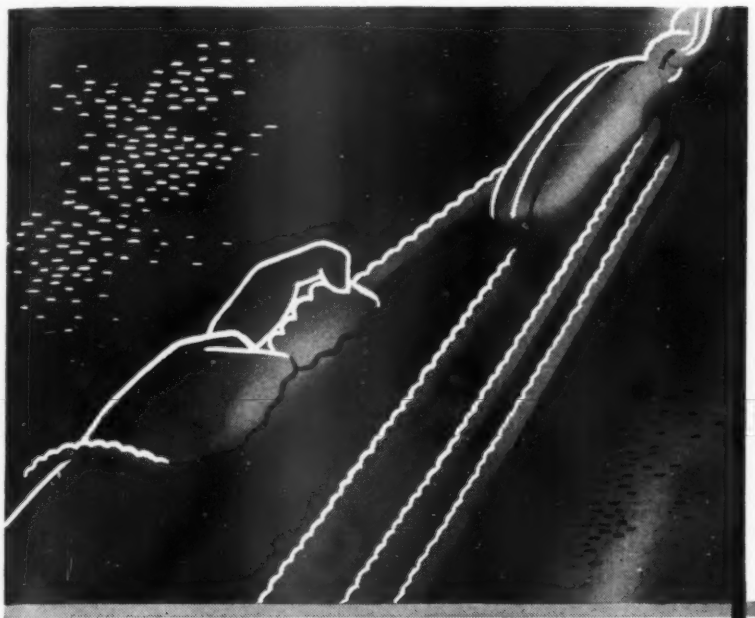
Baccalaureate. — It is The Review's pleasure to be able to bring to its readers (page 497) the baccalaureate address which KARL T. COMPTON delivered before the Class of 1950 on June 8. In hearing Dr. Compton remind them that ethical behavior is the foundation for a successful life, this year's graduates had the unusual privilege of being addressed by the chairman of the M.I.T. Corporation. President of M.I.T. for 18 years, Dr. Compton's lifetime of service as scientist, editor, educator, and administrator — and particularly his wartime and postwar service to the nation, which was often rendered at considerable personal sacrifice — amply serves as illuminating evidence that the righteous life provides its own incentives and satisfactions.

Commencement. — In the commencement address delivered on June 9 before the Class of 1950, CHESTER I. BARNARD, President of the Rockefeller Foundation, discussed three abilities which are the foundation for a successful life. Dr. Barnard's address, "Skill, Knowledge, and Judgment" (page 500) expressed the convictions of one who has had broad background in industry and public service. Beginning his career in the Bell System, Dr. Barnard became president and director of the New Jersey Bell Telephone Company. During World War II he was president of the United Service Organization, and director of the National War Fund. He is a director and trustee of numerous organizations of public service, a fellow of the American Academy of Arts and Sciences, and author of the *Functions of the Executive*.

Valediction. — As they left their studies to take an active part in the affairs of the world, JAMES R. KILLIAN, JR., '26, President, in "Our Shared Convictions" (page 503) bade Godspeed to the Class of 1950, whose 1,225 members constituted the largest graduating class in M.I.T. history. Shortly after this auspicious occasion — the second in which President Killian has awarded degrees as the Institute's administrative head — tables were turned when Harvard University, at its 299th commencement exercises, awarded the degree of doctor of laws to Dr. Killian for his able administrative leadership in the guidance of Technology.

Progress. — In "Printing — the Mother of Progress" which The Review is happy to present on page 506, as one of the Alumni Day symposium papers, COLONEL ELBRIDGE W. PALMER makes a careful review of the development of printing methods, and their contributions to our present mode of life. Colonel Palmer has been president of the Kingsport Press, Inc. for the past 25 years and has been associated with the book-manufacturing field since 1905. During World War II he was deputy director of the Printing and Publishing Division of the War Production Board, and later, deputy director of the Publication Division of the Adjutant General's Office.

(Concluded on page 482)



When sail trimming is required

No business can stay healthy without an occasional overhaul of its production set-up—particularly when a seller's market begins to quiver.

Molybdenum steels may be just what the doctor ordered to reduce production costs, and still maintain the product's reputation for consistent performance.

Send for our comprehensive 400-page book, free; "MOLYBDENUM: STEELS, IRONS, ALLOYS."

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☐ Subminiatures of all kinds

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THE HALLMARK of SUPERIOR EQUIPMENT

Artisan engineers and workmen are skilled in the techniques of metal working. Their combined knowledge and experience in engineering and building special equipment and machinery have been of value to many leading mechanical and process industries.

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THE TABULAR VIEW

(Concluded from page 480)

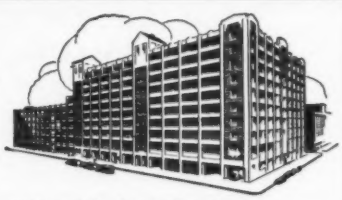
Obsolescence. — Second of the symposium papers on the Alumni Day program was "Is Reading Obsolete?" (page 510) by ANDREW HEISKELL, Publisher of *Life* and Vice-president of Time, Inc. Following studies in this country and abroad, Mr. Heiskell entered editorial work as reporter for the New York *Herald Tribune,* and a year later became associate editor of *Life* magazine in charge of science and medicine. In 1942, he became general manager, and in 1946, publisher of that well-known magazine.

Promise. — In his symposium paper, "The Promise of Technology," which appears on page 512, LUIS DE FLOREZ, '11, outlines a few of the vast possibilities available to the graphic arts industry through full employment of the products of technology. Admiral de Florez is president of the de Florez Engineering Company, Inc., which has done important engineering work in the printing field. He served in the Navy in both World War I and II, becoming director of Special Devices Division of the Bureau of Aeronautics, and deputy chief of Naval Research.

Alumni. — The series of events associated with the graduation of the Class of 1950 and of Alumni Day, 1950, are reported with word and picture in a staff-written article (page 514). A highly important part of this chronicle is the annual report of the Institute's President, which the reader will find on page 520.

The Review is not published during the summer months following July. This issue, therefore, concludes Volume 52. Number 1 of Volume 53 will be published on October 27 and dated November. Readers who bind their copies are reminded that if they possess nine issues of Volume 52, their files are complete. An index to the volume will be ready on September 30 and will be supplied post free upon request.

Macy's Long Island Warehouses
Robert D. Kohn
Architect



What Macy's said of our Service

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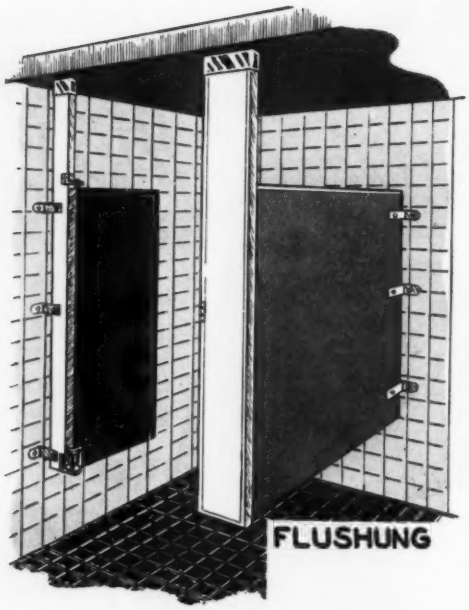

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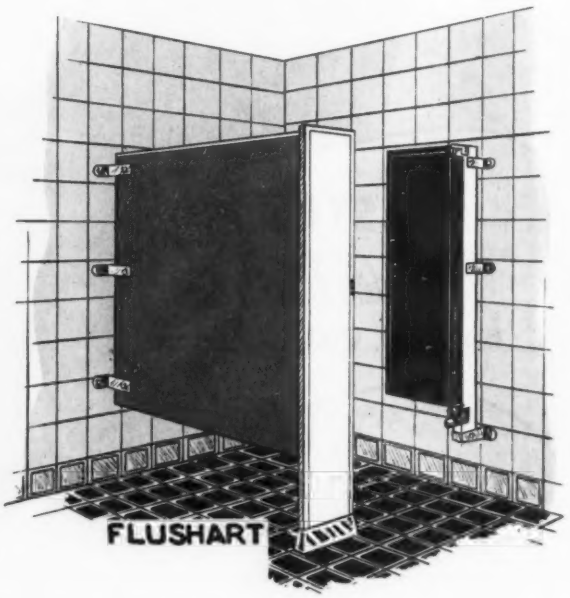

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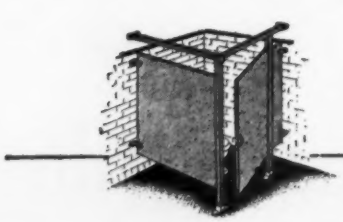

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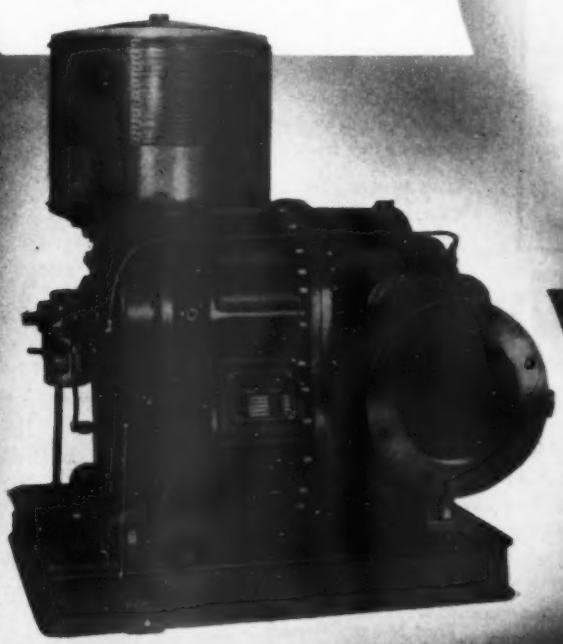

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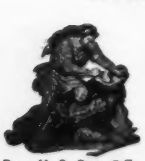

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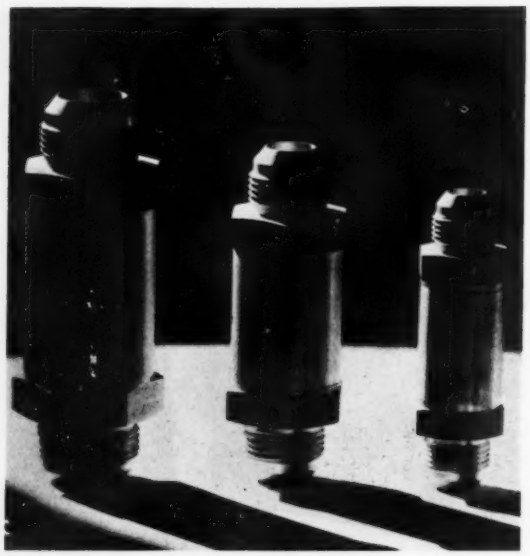

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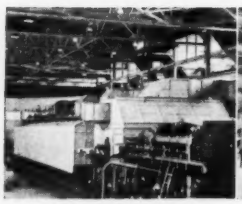

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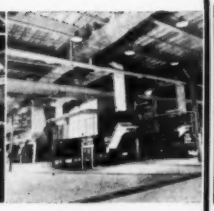

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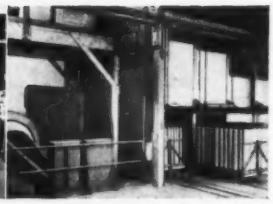

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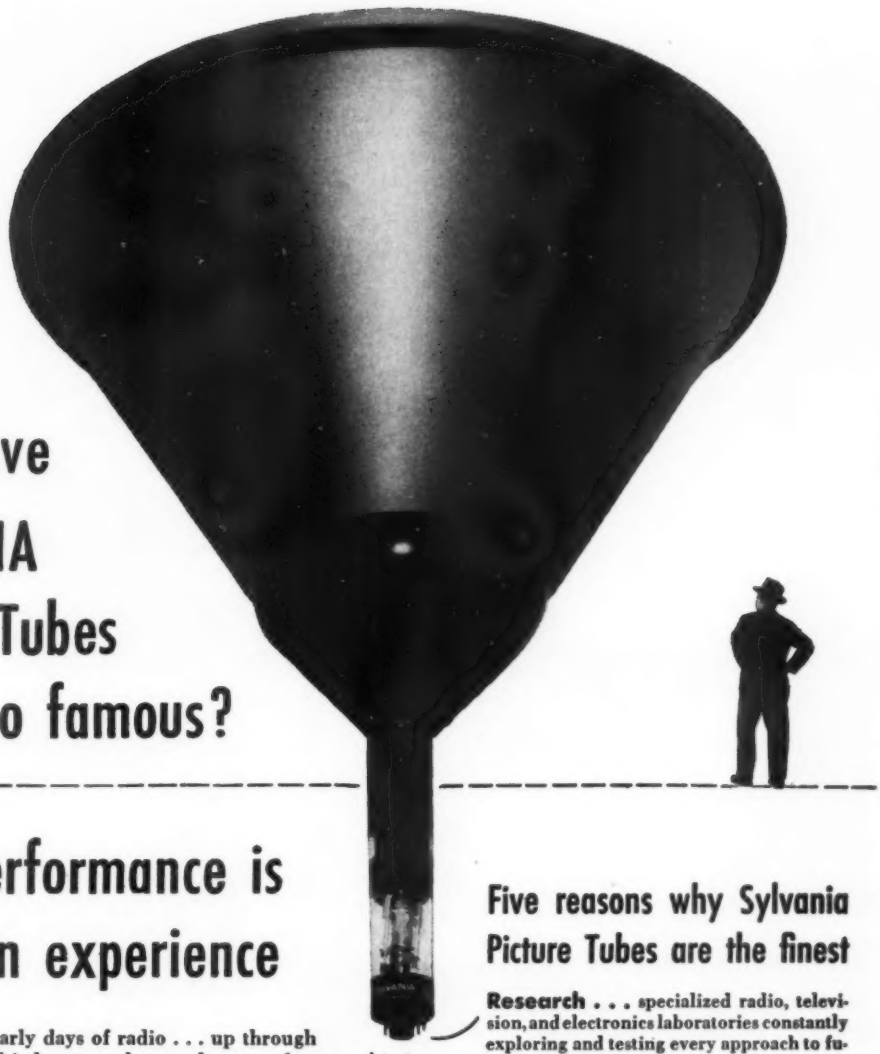

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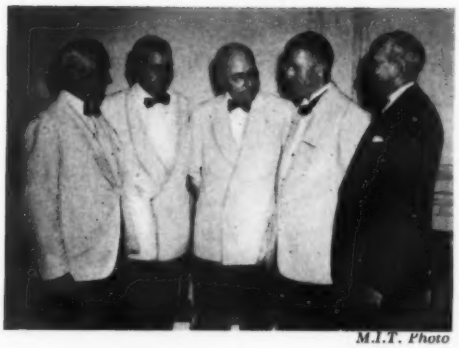

M.I.T. Photo

Grouped, preceding the Alumni Banquet (left to right) *are: Messrs. Compton, Killian, Sawyer, Desmond, and Dalton.*

THE TECHNOLOGY REVIEW

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EDITED AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

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Published monthly from November to July inclusive on the twenty-seventh of the month preceding the date of issue, at 50 cents a copy. Annual subscription, $3.50; Canadian and foreign subscription, $4.00. Published for the Alumni Association of the M.I.T.: C. Adrian Sawyer, Jr., President; H. E. Lobdell, Executive Vice-president; Orville B. Denison, Horatio L. Bond, Vice-presidents; Donald P. Severance, Secretary-Treasurer. Published at Hildreth Press, Inc., Bristol, Conn. Editorial Office, Room 1-281, Massachusetts Institute of Technology, Cambridge 39, Mass. Entered as second-class mail matter at the Post Office at Bristol, Conn. Copyright, 1950, by the Alumni Association of the Massachusetts Institute of Technology. Three weeks must be allowed to effect change of address, for which both old and new addresses should be given.

THE
TECHNOLOGY REVIEW

Vol. 52, No. 9 July, 1950

The Trend of Affairs

Visual Access to Atoms

RECENTLY developed at the Institute is a method for photographing the structure of individual atoms in any crystal, using both X-ray and ordinary optical techniques. The new scheme consists essentially of (1) causing X rays to be diffracted by the crystal, (2) arranging the diffraction pattern as though it had been caused by ordinary light and focused with a lens, and (3) substituting visable light in the path that the X rays would have taken *if* they could have been focused. In this way, the good features of X rays are employed in the system, since they have a short enough wave length to "see" the atoms. The substitution of visible light of long wave length for X rays of short wave length has the effect of scaling up the whole optical image-forming process so that the image is magnified by the quotient of the wave lengths of visible light to X rays. This provides the tremendous magnification of almost a million diameters.

This general procedure was first tried by the British physicist, Sir Lawrence Bragg, but his experimental devices had the disadvantage that they could only be applied to imaging a vanishingly small class of crystals. The more general procedure, developed by Professor Martin J. Buerger, '24, of the Department of Geology at Technology, is capable of being applied to any crystal whatever. The key to the more general system is the device which has been developed for shifting the phases of the diffraction spectra. Each X-ray diffraction spectrum cast by the crystal has a specific phase. If this phase cannot be imitated when visible light is substituted for X rays, in general an image cannot be formed of the atoms in the crystal. Professor Buerger arranged to imitate the X-ray phase by interposing small, tilted, mica windows in each of the diffraction spectra after the substitution of visible light. The exact phase shift is controlled by tilting the mica window a known amount, thereby increasing the optical path through it. The computations required are for the purpose of setting these phases accurately. Mica is employed because it can be selected so that it has precisely uniform thickness over a large area.

The light coming from the diffraction pattern is brought to a focus by a lens, and theory shows that the narrow beams of light must superpose in such a way as to produce an image of the atomic pattern of the crystal, exactly as they do in an ordinary microscope. This image of the crystal pattern, magnified about a million diameters as stated above, is still a bit too small to see, so that it must be magnified somewhat further by an auxiliary microscope. The final image may then be either viewed directly or photographed.

Are Mesons Fleet?

As the first significant result to emerge from studies of nuclear mesons produced by the new 300-million-volt synchrotron, which commenced operation at Technology in January, the mean lifetime of the heavier type (π) positive meson has been clocked at 1.65 (± 0.33) x 10^{-8} second. The π mesons disintegrate into the lighter μ mesons and another particle. (The μ meson further disintegrates.)

Research on the lifetime of the meson was carried out in the Laboratory for Nuclear Science and Engineering by William L. Kraushaar, a research associate in the Department of Physics, and was sponsored by the joint program of the Office of Naval Research and the Atomic Energy Commission.

◀ *"Typesetting by Hand," by Andreas Feininger of Black Star, is reminiscent of an era in which all printing operations were manual. The historical perspective, which Mr. Feininger's photographic study suggests, is in marked contrast to the forward-looking ideas expressed in papers delivered in the Alumni Day symposium under the general title, "Access to Ideas—Is Reading Obsolete?"*

Humane Engineering

BECAUSE of the social implications and humanitarian aspects of the program, the Department of Civil and Sanitary Engineering is particularly proud to be engaged in a co-operative project, with the Massachusetts General Hospital, in a study of leg braces with a view to determining procedures of design to meet the structural requirements imposed on the brace during normal conditions of use. While there has been fairly good correlation between the structural members of the brace and the functions they must perform, there is room for improvement. Failures of braces occur, sometimes with rather disastrous results to the patient; whereas in other cases, braces are unnecessarily heavy for the important functions they must serve.

A second purpose of this study is a fundamental study of the mechanism of human locomotion, with particular reference to that of persons with abnormal gait. The purpose of this fundamental study is to develop a more scientific basis on which to design braces for the lower extremities so that the patient may walk with more normal gait characteristics and permit an increase in the present limited range of the mechanical function of the affected limb. The work is directed by the Committee on Brace Research of the Massachusetts General Hospital, a committee composed of Dr. Joseph Barr as chairman, Dr. Paul Norton, Karl Buschenfeldt, who is chief orthopedic technician, and Robert J. Hansen, '48, Assistant Professor of Structural Engineering, as the M.I.T. representative.

To accomplish the first objective, a special brace was constructed with strain gauges affixed to determine the magnitude and distribution of forces on the brace during use. Preliminary tests obtained to date show that the stresses sustained in certain portions of the brace approach the fatigue limit, and thus indicate possible design improvements, although more data are required before the basic principles of brace design can be firmly established.

A more elaborate program of experimentation was undertaken in the study of the mechanism of human locomotion. For this study, a force plate, capable of measuring the ground reactions of the patient was constructed, calibrated, and tested in the Structural Dynamics Laboratory. This plate will measure the vertical force, the horizontal shears (lateral and longitudinal), the center of pressure of the foot, and the torque about a vertical axis of the patient as he steps on the plate. All independent variables are plotted as a function of time on a multichannel oscillograph. At the same time, synchronized motion picture photographs are taken of the patient in two or three views to afford a time-space record of the affected limb and supporting brace. Simultaneously, the stresses in various parts of the leg brace are recorded so that a complete distribution of force may be determined at any instant of time. From these records, using equations of mechanics, the forces in the limb which is affected may also be determined.

From such a study as this, it is hoped that the fundamentals of human locomotion may be determined so that a rational basis for the design and construction of leg braces can be established.

Migration Study

FOR a reaction to take place in the solid state, it is generally necessary that atoms migrate from one position to another. When atoms move through the same element, the process is designated as self-diffusion. Allotropic transformations, creep, recrystallization, and grain growth are examples of solid state changes involving self-diffusion in metals.

As the first step in a long-range study of diffusion kinetics in steel, the Department of Metallurgy is investigating the fundamental problem of self-diffusion in iron. This program is being carried on by Francis S. Buffington, '38, and Israel D. Bakalar, G., both research assistants in the Department of Metallurgy, under the direction of Professor Morris Cohen, '33, of the Department of Metallurgy. Grants from the Engineering Foundation and Titanium Alloy Manufacturing Division support this work.

The use of radioactive iron (Fe^{55}) provides a means of distinguishing between iron atoms, so that the self-diffusion process can be observed even in pure iron. A thin layer of iron containing radioactive Fe^{55} is electroplated on one face of a disc of high-purity iron. At an elevated temperature, atoms diffuse from the radioactive layer into the inert lattice, and radiation from the Fe^{55} atoms is partially absorbed within the specimen. The diffusion process therefore results in a decrease in the intensity of radiation emanating from the face originally containing the radioactive layer. The self-diffusion rate can be calculated from the ratio of the radioactive intensity from this face after diffusion to that before diffusion.

Up to the present time, the effect of temperature on self-diffusion rate has been investigated in both allotropic forms of iron, the face-centered cubic structure (γ-iron) existing between 910 degrees C. and 1400 degrees C., and the body-centered cubic structure (α-iron) existing at all other temperatures below the melting point. At the transformation temperature, 910 degrees C., where both phases coexist, the self-diffusion rate in α-iron is found to be 330 times greater than that in γ-iron. This fact suggests that the diffusion mechanism is probably involved in the sintering of iron powders since, as is well known, powder compacts sinter at a much greater rate just below the transformation point than above it.

The data gathered so far have been used to calculate the average activation energy that an iron atom needs before it can overcome the atomic binding forces and jump from one lattice site to another. It has been found that iron diffuses more rapidly in the body-centered phase than in the face-centered phase because the atoms in the former are less tightly bound and have a greater jump frequency. In agreement with the results of other systems, the preliminary work carried out at M.I.T. has tended to show that the activation energy needed for diffusion in each allotropic phase is essentially independent of temperature. Those experiments will now be extended to include the effects of various alloying elements, plastic deformation, and grain size upon the activation energy. The results obtained should help considerably in clarifying the role that self-diffusion plays in the heat treatment of plain carbon and alloy steels.

Incentives and Satisfactions

". . . Seek Ye First the Kingdom of God, and His Righteousness: and All These Things Shall Be Added unto You"

BY KARL T. COMPTON

BACCALAUREATE ADDRESS

My professional training in both writing and speaking was centered around the delivery of reports on scientific matters, where the emphasis was on a maximum of clarity with a minimum of words. Unlike the orator or the preacher whose objective is to stir men's souls or incite them to action by persuasion and exhortation, the purpose of a scientific report is to describe some discovery or to convey some idea, and the less embellishment the better.

The difference between these two types of public address was forcibly brought home to me by an experience during one of my first academic positions, on the faculty of a western college. In this college each member of the faculty had to take his turn in leading the daily chapel exercises. The program called for a 15-minute address. In one way I was well fortified for this unexpected duty because, for a number of years, I had made a practice of keeping notes on sermons or similar addresses which had impressed me as being particularly significant. Consequently, as my turn to lead the chapel exercise approached, I selected a subject, went carefully over these notes to assemble some ideas, and wrote out my address, not trusting myself to speak extemporaneously. The difficulty, however, was that there was no subject on which I seemed to be able to talk for more than five minutes without saying everything which seemed to me to be worth saying. I vividly recall the pained expression on the face of the president of the college when I closed my remarks at the end of five minutes and he realized that his student body had 10 minutes of unscheduled time during which uncontrolled confusion might disrupt the orderly procession of academic events.

I thought at the time that my inability to fill up the scheduled 15 minutes was due to my success in saying what I had to say clearly and briefly. So far as I could see, I said everything of importance which had been included in the much longer sermons on which I had taken notes. The thing which I did not do, and could not do by temperament or training, was to exhort, to plead, to re-enforce by repetition. However, on looking back more maturely on this episode, I realize that another major factor was that I really did not have very much to say.

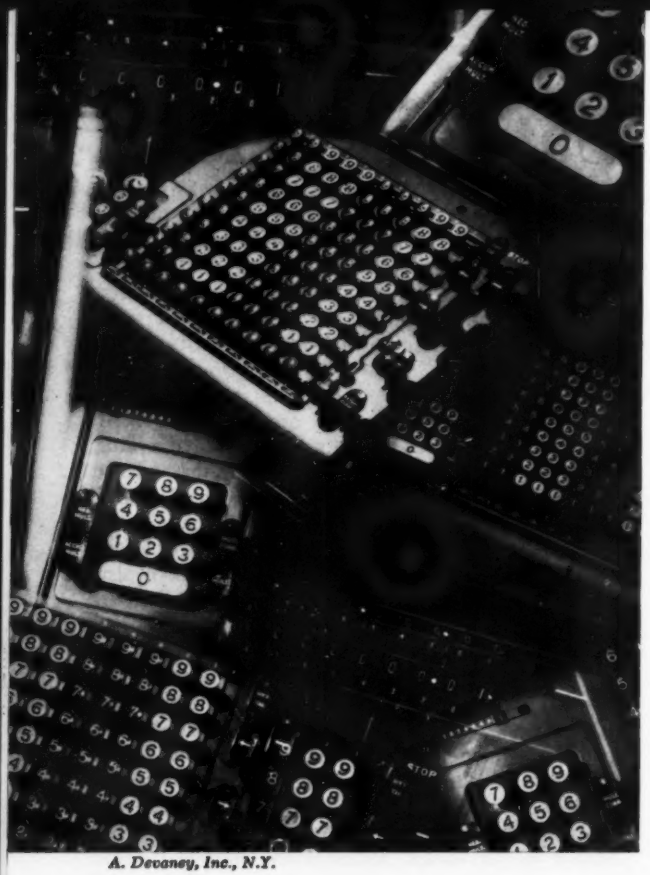
Since that time I have had to try to learn to speak on a wide variety of occasions, but I freely confess to you that it is on an occasion like this that I feel most inadequate – inadequate to give you something really helpful as you are about to go out from this institution into what we call rather broadly "the world" – inadequate to express for myself and for my colleagues of the M.I.T. staff the deep feelings of hope, ambition, and affection which we have for you. This affection may often have seemed lacking, or at least very skillfully concealed beneath the grades and quizzes which, like fertilizer on a field, have been spread to help you sprout and grow. But the affection is there and is very real, and will blossom also into pride as we follow your future careers. Next to parent and child, I suppose the relation of teacher to pupil is the greatest bond between the older and the younger generation.

My theme today is "Incentives and Satisfactions" and I am developing it around the general thought of a text taken from Christ's Sermon on the Mount: "Seek ye first the kingdom of God, and his righteousness: and all these things shall be added unto you."

We have a well-known slang expression, "What makes a person tick?" What is the motive power? What is the incentive which keeps a person going? For it is certainly true that physical, or mental, or nervous fatigue seldom results from sustained effort if this effort is motivated by an objective which one pursues with enthusiasm and with some sense of worth-while accomplishment.

In seeking the answer as to what are the incentives which make people operate as they do, philosophers have argued between two extremes. One group maintains that people are motivated only by the desire for pleasure or satisfaction. The other group would maintain that people can be motivated by inherent feelings of affection, loyalty, and duty. The first group, however, would argue that people who think they are motivated by affection, loyalty, or duty really behave as they do because they take pleasure in so doing. A philanthropist gives generously or a martyr suffers acutely because in so doing he takes pride in living up to a principle by which he likes to steer his life.

Of course philosophers like to get the simplest possible interpretations, and sometimes the interpretations are oversimplified. The same thing is true, for example, of physicists. In my student days, physicists recognized the existence of electrons and protons, and tried with moderate success to develop an electron theory of matter. Then came the photon and we had three elementary particles, the electron, the proton, and the photon, and some wag said that if we also added to these the moron we would include the entire universe. However, it was not long before it was discovered that electrons and protons could be both positive and negative; and that there were neutrons, and neutrinos, and now mesons of several different types; and it is recognized that energy can shift from one of these forms to another. Thus we see that the



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character of the physical universe is far more complicated than it was thought to be 30 or 40 years ago.

Similarly, in describing human characteristics, people can shift from selfishness to generosity, from degradation to nobility, from crime to service. The most basic aim of education and of religion is to emphasize the nobler motives so that they become the predominating traits of character. Here it is pertinent to quote from the Proceedings of the Tennessee College Association meeting in 1943 (page 35): "The universities have given the world the guidance it needed in science, economics and sociology, but not in the knowledge of good and evil. Hence they have failed to help civilization where it most needs help."

What are some of the common objectives for which men work? They are such things as wealth, or power, or security, or recognition. They may involve position, advancement, and public esteem. The desire for such things constitutes one class of incentives. These objectives are all desirable. However, they have one thing in common in that they are primarily self-centered. Wealth for wealth's sake, power for power's sake, and recognition for recognition's sake are not very noble ambitions. They may, however, be not only very pleasant, but also very useful in attaining some higher objective, and this leads to the question, what are some of the higher incentives?

As higher incentives I would suggest such things as duty, loyalty, service, or constructive achievement, all of which are distinguished from the former set of objectives by the fact that they imply service to some cause, rather than the satisfaction of some personal and perhaps selfish desire. They are all aimed at something outside of, and bigger than, oneself.

Christ had a remarkable ability to brush aside the unessentials and to emphasize the most basic features of human conduct and of religion. When he said, "Seek ye first the kingdom of God, and his righteousness: and all these things shall be added unto you," he stated in very simple terms a very great truth. Very few men who have been actuated by selfish motives have achieved real greatness. Very many men who have been actuated by the desire to improve the lot of mankind have achieved real greatness and have, at the same time, achieved a personal satisfaction which the self-centered person can never experience. Not only does satisfaction flow from service to others, but many of the other objectives – like recognition, or security, or wealth – are likely to come in greater or less degree as by-products.

Some 15 years ago or so our student body was addressed by Henry C. Link, author of a remarkable book and best seller, *The Return to Religion*.* Link gave a broad interpretation to the religious attitude, which he described as loyalty and service to a cause which takes precedence over personal selfish desires. One example which he cited was of a player on an athletic team, where he pointed out the contrast between two types of players. One was the grandstand player who had continually in mind what the crowd or the newspaper reporters would be thinking and saying of his performance; the other was the team player who, for the sake of the team, subordinated his own self-interest, and devoted his every effort to contribute to the team's objective. To this player, the success of his team was, for the time being, his religion. This latter type of player is the more useful.

Mr. Link's illustration has frequently recalled to my mind an incident in a football game in which I played about twice as long ago as you young men were born. The game was somewhat remarkable in that the score stood at 95–0 in our favor when it was ended by the fact that our opponents had no more substitutes with whom to continue. But what I remember most vividly was hearing the last player to be carried off the field moaning in his daze: "I'd die for Old Berea, I'd die for Old Berea." I did not know him, and have never heard of him since, but he has always had my respect, and I have often thought that, at least in his loyalty to his cause, he was the kind of person I would like to be associated with in an organization.

Another example is that of a young man in college. Of course he goes to college in order to secure an education and a training. If, however, his college career is completely described by the attitude, "What can I get out of it?" then he is certain to get out of it far less than is available. If, on the other hand, he plays his part in the college community, takes some responsibility for group activities, for the maintenance of good morale and the good name of the institution, for the assistance of any of his fellows whom he can help, perhaps for helping his family as they make sacrifices for him, or if he becomes absorbed in some scholarly pursuit, then this young man is going to get out of college far more than if his conscious objective is to get out of it all he can just for himself.

Then, after college, comes the job and here again long experience and innumerable examples prove that

* New York: The Macmillan Company, 1936, $1.75.

the person who is motivated first of all by an intense concern for the welfare of the organization which employs him, and an intense desire to contribute to it effectively through his own job, is the person who is not only happy in his work but whose services are valued and recognized by his employer.

The attitude of an employer in these matters is well illustrated by the following experience. A company was about to launch a new enterprise which called for the leadership of a man of high ability and imagination. The job was really an exciting one in its possibilities. A young man of excellent academic record was being interviewed for appointment to this position and the company interviewer outlined the great opportunities in this new development, and then asked the young man if he had any questions. The young man asked, "What assurance can you give me of promotion?" The interviewer closed the interview right there. The young man was evidently egocentric. Ahead of him would probably lie failure and disappointment both to himself and to whomever might employ him, unless his attitude were changed.

I have frequently been asked by young men for my advice to them in the choice of positions which may be open to them. Advice is a hard thing to give because one is always conscious that it may prove to be wrong. However, there is one piece of advice which I think can very seldom fail to be right, especially for a young man at the beginning of his career. It is to take whatever job may be open which gives him the best opportunity to do the thing which he is most enthusiastic about doing. Where there is this incentive, there is likely to follow both personal satisfaction and the constructive achievement which will cause all other things to be added unto him.

It is an interesting phenomenon, and very encouraging, that times of emergency call out the best that people have to offer. A famine in China calls forth a generous response from America. A flood in Winnipeg brings in help from all over Canada and the adjacent parts of the Uinted States. People submerged in routine or selfish pursuits, and even criminals, frequently rise to acts of heroism and self-sacrifice in such emergencies. Perhaps we can say that one of the very few good results of World War II was that it tended to draw forth the best that is in people of good will, and to develop the spirit of service and sacrifice.

We all saw many examples of this during the war, and these examples included not only individuals but also organizations. A few organizations were slow to respond to the emergency, preferring to carry on their normal business with a minimum of interruption. Other organizations rose quickly to the challenge and without mentioning any other names I think we have all been very proud of the record of M.I.T. which, from the beginning of the emergency, followed steadfastly the policy that no self-interest of the institution, or of its personnel, should be allowed to stand in the way of the maximum contribution which we could make to the national effort.

Even in this institutional relationship it was very true that the result, "All these things shall be added unto you," followed from the decision not to seek these things for the sake of the institution, but to subordinate everything to national service. For it is true that those institutions and companies which adopted wholeheartedly the policy of service have, by and large, been those which have come out of the period of war emergency with increased prestige, resources, and *esprit de corps* – and this in spite of what seemed to be sacrifices at the time.

In saying this, I am not arguing that high motives should take precedence over lower ones simply because greater benefits are gained thereby. The high motives should be followed because they are high motives or else the position is shallow and unreal. But I am pointing out simply as a fact the general truth of Christ's statement, "Seek ye first the kingdom of God, and his righteousness and all these things shall be added unto you," or, interpreted in more mundane terms, "Seek ye first to do the things which should be done as a duty or as a service, and all the other things will follow."

At this point it is perhaps well to ask a very practical question. Granted that high-minded objectives are of good repute and bring satisfaction, just how do we go about the putting of this ideal into practice? Here I would have to say that there are many elements which enter in – elements of early training, of personality, of education – many of which may be in the past. In the future, however, there are the accidents of opportunity, there is the future education which can come from self-discipline and directed purpose, for opportunity always lies ahead and it is never too late to seek to do better or to make each decision wisely as opportunity arises.

Some of you may know of a very interesting school paper called *The Next Voter* which is published by the students in the political science course at Brooks School in North Andover. In the issue for this June, the editors have assembled the opinions of more than 70 people of varied prominence and distinction on the subject "The Best Advice I Can Give to an American Boy on his Graduation." I should not, without permission, quote some of the very excellent advice which is there reproduced, coming from President Truman, former President Hoover, Secretary of State Acheson, General Marshall, General Bradley, President Stassen, and many others. The advice covers many qualities of character and types of activity. It includes such subjects as work, tolerance, develop-

(*Continued on page 536*)

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Skill, Knowledge, and Judgment

These Three Abilities Are Needed for Self-Development: All Are Relevant to Problems of Living and a Career

BY CHESTER I. BARNARD

COMMENCEMENT ADDRESS

COMMENCEMENT formally marks the transition between two quite different ways of life. The interests, responsibilities, and the hazards to success of the undergraduate differ radically from those of the graduate. Although he must still keep up his training and keep on learning, the graduate is confronted by two new situations: he is on his own and he is expected to produce. He is now a citizen. In his new role his success will be determined, not primarily by his intellectual equipment and capacities, but rather by the way in which he employs all of his faculties in a succession of concrete situations over which he can have little control. In meeting these situations, he may normally expect to derive a real advantage from the knowledge and training received during his academic career if this knowledge and training are properly combined with certain more intangible abilities not as a rule acquired in student life. These other abilities may turn out to be of prime, and even of almost exclusive, importance. To have had the opportunity of intellectual development afforded by this Institute is a valuable privilege, provided the danger is avoided of that excessive emphasis on intellectual capacities and attainment which may lead to overrating of one's self and an equally pernicious underrating of others. Recognition of this danger should bring about an early appreciation of the importance of the above-mentioned, not exclusively intellectual, qualities.

For fear of being labeled "anti-intellectualist," many hesitate to endorse this rather unusual view, though I am sure it is worthy of more general acceptance. However, it was expressed in a statement recently made by Professor William E. Rappard of the University of Geneva. Although Swiss, he was born and spent most of his early youth in the United States. He was educated at Harvard, Geneva, Berlin, Munich, Vienna, Paris, and Lyon. He taught in this country, and later spent many years at Geneva. He knows the educational processes and their products on both sides of the Atlantic. Referring to an interview some years ago in which he was asked to compare American students with their European counterparts, he said: "What I have seen of Americans here confirms me in the opinion I had formed before the first world war. Compared with European students, the American boy or girl of about 19 or 20 strikes me as more intelligent but less well trained." He added that possibly some of them were more intelligent because they were less trained, and that this was not as absurd as at first glance it might seem to be. He further spoke of the capacities of Americans in some situations as "untrammeled by any excessive bookish preparation," which he regarded to be "an asset which cannot be valued too highly."*

In talking to my associates about the difficulties of reaching decisions, I myself have sometimes half facetiously put this same view in the form of a question: In what kinds of situations is it rational to be irrational; when is it irrational to rely upon rational methods? I can get no answer to my question. This paradox reflects one of the most persistent problems of responsible behavior. Its significance has been recognized to some extent in recent developments in the fields of applied mathematics, mathematical logic, in what is called operational analysis, and especially, in probability mathematics and mathematical statistics. The theoretical solution of these problems we must leave to the future effort of logicians and mathematicians, as well as of psychologists and neurologists. What we are concerned with now is the significance of this state of affairs for the postacademic period. In considering the possibilities for intelligent and effective behavior in the immediate future, the graduate may well ask: "What kinds of abilities do I need to develop for myself? What kinds should I recognize in others as relevant to my own problems of living and career?" My answer is: At least three kinds of abilities which I shall discuss under the headings of Skills, Knowledge, and Judgment.

Skill

On the subject of skills, I should like to mention, first of all, bodily skill. By this I mean the ability of the individual to control and direct the movements of his body. Standing, walking, sitting down, and lying down are the common abilities of this kind, so fundamental to all others and so obvious and universal that most people take them for granted. Not until some disease or accident prevents the exercise of these skills, do we see what a handicap the lack of them entails. Bring down your ambitious student with a high fever and he will soon be aware of the limited intellectual capacity thereby imposed on his system. Work of any kind is beyond his physical and mental ability.

The impairment of fundamental bodily skills has often hindered the completion of great engineering projects, notably the first attempt in the 1880's to build the Panama Canal. Newcomers from the North were terror-struck by the deadly and spectacular character of yellow fever, but in the construction programs, malaria, which produced a vast amount of chronic disability, was an even more serious obstacle.

*"The Impact of American Students on European Universities," *Institute of International Education News Bulletin*, April 1, 1950, page 3.

The fundamental bodily skills can be developed in special ways that are often greatly admired. The golfer who shoots in the 70's and 80's has learned to control his movements in a fine degree. So have the concert pianist and the operatic soprano. Surgery, molecular biology, microchemistry, electronics, and countless other fields, many of them directly concerned with the application of science and technology, demand highly specialized bodily skills. We are living in a society in which the material aspects of living require the type of extreme specialization in which these skills are indispensable.

Without going further into a discussion of the common and special skills, I merely stress the fact that they are, as a whole, basic to acquiring knowledge as well as to its application and to the appraisal of individual abilities. I now pass to three special skills which at first you may regard as intellectual, rather than bodily, skills. In some cases they are both.

The first is skill in getting along with people. This is something that intellectuals subscribe to on paper, but are rarely able to pass along to younger people. There is not yet much that can be taught by precept and reasoning in this sphere. Young people learn by imitation and by practice. Both behavioristically as well as intellectually they should realize that getting along with people is of major importance. It is not just a matter of pleasant relationships. Whatever the career a man elects, if he has not acquired the ability to get along with people, he cannot stimulate the best in others or elicit their co-operation. He lacks elements essential to successful effort.

Recently the organization with which I am connected made a substantial grant for the establishment of a technical division in the government of a certain foreign country. We had confidence in the character and technical competence of the man who was promoting the enterprise. It so happened, however, that our support was contingent on additional support to be obtained from the government itself. This was not forthcoming because the promoter could not get along with other people in other departments of the government, more particularly, the treasury. Excessive enthusiasm led him to disregard the position and the interests of his colleagues. I believe his chief limitation was sheer inability to get along with others, not lack of personality, or even of intellectual persuasiveness, but excessive centering upon his own, ultimately unselfish, interests. Certainly it was not a question of intellectual competence. The point is that successful relationships with other people require a skill which transcends intellectual competence. The secret lies in commanding the respect of others.

Closely related to this top skill of getting along with people is the ability to persuade. I have talked many times to engineers on this subject, and I used to despair of their appreciation of the art of persuasion and its social importance. Happily, this effect of rigorous intellectual training is modified in the technical colleges, through courses in the humanities, with emphasis upon the human and social aspects of life, and through instruction on human relations in industry. Nevertheless, it should be repeated that the art of persuasion is a prerequisite to social progress. In the last analysis, persuasion is the art of presenting products, technical ideas, and abstract social possibilities in such a way that they are related to the aims, goals, and ideals of others.

Persuasion, too, is an indispensable skill if professional knowledge of any kind is to be effectively and economically utilized. Persuasion is not a method of argument, or of abstract demonstration. It is much more a capacity to divine the essential interest and responsibilities of others so effectively as to impart to these others, in terms they understand, knowledge of the resources—material, intellectual, and moral—which are open to them.

The last of the skills to which I invite your attention is at once the most subtle and the most difficult to describe. It is the skill, understanding, and know-how that comes normally from intimate personal association with materials, systems, and people. As one of my scientist friends once phrased it, it is the skill of "intuitive familiarity." Whether you consider laboratory or field sciences, administration, politics, education, or art, it is a skill that comes from patient hard work with the subject matter. Usually it is untransmittible through symbols, example, or demonstration. Its intellectual aspects are not salient, but it is expressed in the capacity of scientists, physicians, and executives to make diagnoses, select remedies, and sense impalpable obstacles and dangers. They cannot explain any of these things with words – at least not quickly and easily – but the exercise of this intuitive skill is apparent in any sphere of endeavor to those who look for it.

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Knowledge

Knowledge, and by this I mean every variety of knowledge, rests upon the existence of skills of many kinds. Many of the basic skills on which we depend for our very existence are biological skills.

However, even though we could not do without them, biological skills are not exclusive factors in the acquisition of knowledge. The crucial elements in man's ascendancy over all other forms of life, are those skills which are intrinsically human. I refer especially to man's skill in dealing with other members of his species – the skill, now developing into an art and a science, of human relations. Above all, it is our skill in verbal communication which serves as the instrument for attaining, utilizing, and transmitting knowledge. A corollary to this is the uniquely human ability to conceive of things in the abstract. It is through language communication and abstraction that the knowledge, hidden or implicit in skills, becomes explicit and overt. Through abstraction and communication we extract from skills statements of fact and general propositions concerning facts. These become the keystones in the arch of knowledge.

Knowledge can usefully be divided into two broad categories. The first consists of the large body of organized, formal knowledge, which, theoretically at least, is available to anyone. It is universally applicable and of widespread interest. It is in the kind of knowledge that can be put into books, taught in schools, or acquired by deliberate observation and experiment. It includes all scientific knowledge and much knowledge in the nonscientific spheres, such as history, law, and literature. It encompasses the entire content of what is referred to as "book learning."

There is an important point about this kind of knowledge that deserves mention here: namely, that in recent generations it has expanded swiftly and today is still growing at an unprecedented rate. Time was when a learned man could lay claim to mastery of a large part of the existent knowledge, or at least to a large part of the knowledge available in Western civilization. Today the most learned man is, relatively speaking, still an ignorant man. The store of knowledge is so immense that what he knows is slight in comparison to what he does not and cannot know. Our great resources of documented knowledge are a social, rather than a personal, possession. Awareness of this fact should generate a proportionate sense of humility. It should also bring us to realize that we are faced with a formidable new technical problem: that of making available and of communicating to others our vast accumulation of organized knowledge, so that it will be there for them to use when they need it. This is a task that we dare not neglect, for the human life span is short and human memory still shorter.

The second kind of knowledge is much less well recognized. As a matter of fact, many people are unwilling to grant that it is knowledge at all. I am speaking of the local and personal knowledge of everyday and commonplace matters. This knowledge is not of general interest and little of it is recorded. Most of it is only of personal value, and almost none of it is scientific in character. Yet it is as essential to the acquisition of the general knowledge as are those basic skills that we have been discussing. It consists of knowledge of the particular individuals with whom you come in contact in all your various life situations, knowledge of the specific materials with which we work, familiarity with the specific times and places with which we are concerned, and, it may be, unarticulated understanding of the channels of events around us. It includes what one learns in Al Smith's famous College of Hard Knocks. Much of it is knowledge of one's self. Each of us is a little island of this kind of knowledge, an island that grows quite quickly with early experience, more slowly later, and finally ceases as the losses of memory exceed the gains produced by new experience. The aggregate volume of this highly personal and intangible knowledge, unlike more general knowledge, probably does not greatly differ with the centuries or with social status.

I think that enough has been said to make my point; but it would not surprise me if you said, "Of course, but why discuss it? It is obvious; no one is devoid of this kind of knowledge; everybody has it and no one is much interested in the personal knowledge that others have." This is true and the discussion would be out of place here if not for one crucial fact. And that is that this kind of personal, on-the-spot knowledge, too often underrated, is absolutely indispensable for the acceptance and the discharge of responsibility for all and any action, and the capacity for responsibility is a vital component in the execution of useful work or the development of careers in every field. It is also an important ingredient of judgment, of which more later. It must be emphasized that whatever the extent of our skills, our intellects, and our professional knowledge, these cannot be effectively or consistently applied except insofar as we are alert to the facts of our immediate personal situations, aware of their relevant immediate histories. We must know where we are, where we want to go, and how to get there. Nor can we afford to have less than a complete ability to understand and speak the language of the commonplace world that surrounds us.

All of this is essential to dependable behavior, which in turn is a prime requirement of responsible effort. It is customary to stress moral character in connection with responsibility, rather than adequacy of local personal knowledge, and this too is correct. But the fact remains that the best intentions and the highest principles will not guarantee truly responsible behavior if a man is living in the clouds or is out of touch with his environment and with his coworkers. In such a circumstance, even the greatest skills, the most profound knowledge and the highest intellectual competence are likely to lead to failure. This is what we mean when we say that a man must "know the ropes" before he can effectively apply his talents. Another way to epitomize the sense of this discussion is to say that only rare individuals in highly protected positions could be useful if they were persistently absent-minded.

It follows, therefore, that although everyday, personal knowledge, except in some phases of psychology and sociology, can have no place in the curriculums of our schools, it is far from trivial in importance. Hard

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Our Shared Convictions

Tolerance, Willingness to Accept Change, and Faith in the Future and in our Spiritual Unity Stand as Bulwarks Against Doctrines of Regimentation

BY JAMES R. KILLIAN, JR.

VALEDICTORY ADDRESS

You, the class of the mid-century, must surely feel the responsibilities and the distinctions which your graduation date confers upon you. You cannot escape the significance of the mid-century as a symbol of transition, a time for reaffirmation, a junction point of destiny. Since these milestones of the calendar are always times of stocktaking, of looking backward and peering forward, I would like today to inventory certain of your present responsibilities which bear upon your future obligations as citizens. I particularly want to urge that you accept the mid-century designation as a continuing mandate to re-examine your personal philosophy to make sure that it provides you with a credo and a code to guide you in the years ahead.

This graduation for most of you marks your entry into the workaday world and into active citizenship. Your responsibilities take on new dimensions and new orientations. This decisive moment in your personal careers may also be a decisive moment in the history of the civilized world. You enter upon the stage of life at a climactic period. This is your destiny – to participate in and influence tremendously significant events.

When you entered college in September, 1946, the mood of exultation and hope that followed the end of World War II was fading into misgivings. A radical adjustment of hopes and attitudes was taking place. By then it was beginning to be generally apparent that the Russians were not acting in good faith to support those principles of conduct which they had endorsed through the United Nations charter. It was that September, when you were beginning to find your bearings in the new world of college, that Americans as a whole were beginning to find their bearings in a new world of conflict. The Byrnes-Wallace dispute that month, over the policy of firmness with Russia, dramatized the shift that was taking place. Subsequent months saw ever-growing support of a foreign policy for the United States which accepted the grim reality of a world divided.

Certainly you who have lived such a large fraction of your career involved both in war and in cold war have a right to hope that the mid-century point marks a change in sign from plus to minus in the century's curve of crisis. We who congratulate you today cannot guarantee you any such happy change. To do so would be to leave you incredulous or to mislead you. We can say to you that we have confidence and faith in your well-tempered strength to meet the uncertainties of the future and to meet them courageously. The official act we perform today is evidence of this confidence. Your diploma is the public recognition of an achievement towards which the plans, hopes, and sacrifices of your families and yourselves have been directed for many years. This accomplishment is a good augury for the future.

What we cannot know about, or provide you, is an inner resource which only you yourself can construct – the personal philosophy, the credo, the bench marks to live by which are so important to each of us in a period of tension and turmoil. The importance of this credo for a time of crisis is my theme today, although I am going to discuss it indirectly by concentrating on those beliefs that help to unify our country.

A little girl awakened to the mysteries of anatomy by the picture of a skeleton, asked her older brother what the skeleton was for. "If *you* didn't have a skeleton," answered her brother, "you'd just be a heap." Similarly I say to you that if you don't have a philosophy or code of action, you are likely to be just a squashy heap without resilience and without defenses against crises.

At this stage Americans particularly need to clarify and consolidate their values as Americans. In the face of attacks by communism and totalitarianism, the American cannot afford to be a squashy heap. As the late Peter Marshall, chaplain of the Senate, once prayed: "Give us clear vision that we may know where to stand and what to stand for, because unless we stand for something, we shall fall for anything."

Knowledge about our American democracy and its special ideals and values is the strongest weapon we can now muster. It is also the best insurance against the hundred percenter and the zealot – the zealot, of course, being a person who redoubles his efforts when he has lost sight of his aim. What are these shared convictions which create a common faith in America and which, therefore, buttress our solidarity and union as a nation? Those of you from other lands who graduate today will not be uninterested in this topic, for I am sure it is a part of your educational objective to know something of this nation, and the objects of its society.

Many of these concepts and goals are self-evident, as the Declaration of Independence says they are . . . life, liberty, and the pursuit of happiness; governments deriving their just powers from the consent of the governed; government of the people, by the people, for the people; civil liberties; equality of oppor-

tunity; social justice. These objects of our society we now assume to be basic and self-evident. I speak today, not of these, but of those elements of faith and outlook the possession of which can make all Americans kin. I suggest that there are four of these common denominators in the outlook of Americans.

First, there is a deep-seated faith in the future, the kind of faith implicit in these exercises today, and in the growth and evolution of this institution. The American people have always professed a faith in the future; democracy requires it; our economy is based upon it; the American spirit is vitalized by it.

Faith in the future has made America one of the most progressive nations in the world. Progress can only come when men and women are ready to risk their lives and fortunes on the future – and in this country we have always believed that there is a future worth taking a risk for. That is why the pioneers in this country gave up security to push westward and start new communities. It is because of this faith that men and women have risked their savings on new industrial developments. Having faith in the future, men and women have accepted the uncertainties and interdependencies of an industrial civilization in order that man's welfare can be advanced. Risk-taking is a basic characteristic of democracy and of progress. Risk-taking demands faith. I hope that you of the Class of 1950 have this faith in yourselves, that the siren call of security will not divert you from your course. For ambitious young people, security is the hobgoblin of the timid, the feather bed of the fearful.

Implicit in the American faith in the future is the conviction that life has meaning, and that this meaning is discoverable. This conviction is identical with the conviction of the scientist that there is order and harmony in the universe which can be revealed by orderly research, that "man is capable of discovery, and turning to human use, more and more of the structural truth about his universe and his own mind and body." Americans find unity in this belief in the fulfillment of the future.

The second common denominator in the American outlook is a belief in the validity of change – a willingness to accept change. "The genius of America," says David Lilienthal, "is in its ability to make adjustments. That was the condition of conquering a virgin continent. The majority of us recognize a fact when we hit one, and move over. . . . We are adaptable, and because we are adaptable we are strong." This adjustability explains in part why we have governed ourselves longer than any people on earth, why within the framework of a constitution hardly changed since its adoption, we have steadily shifted from a representative system to a democracy, evolved a two-party system unforeseen by the founding fathers, and adjusted the Federal Government to the changing degrees of centralization called for by wars and peace and continental expansion. By such continuous adjustments we have avoided, save for the Civil War, the violence and revolution which accompany changes in a more rigid system.

Again we can draw an interesting parallel with the spirit and outlook of science. Scientists are constantly being corrected and even disproved by each other, and there are no hard feelings. Such a process of refinement and adjustment is taken for granted and approved as essential to the progress of science. Fortunately a similar attitude sems to be deep-seated in American life, a readiness to modify our understanding of the right way whenever it is found to be in error in respect to the general welfare.

A third unifying concept is a tolerance of differences, a repugnance for regimentation, and an acceptance of dissent. Someone, doubtless a Frenchman, once remarked that America has created one sauce and 367 religions. The impressive thing is that with only one sauce to sustain us, we can tolerate so many different and contending theologies, or so many different races and varieties of people, so many different beliefs, that we can have this enormous diversity and yet still maintain a unity resting upon the concept that diversity is good. America is cemented together by this concept, which rests upon another and more fundamental belief – the belief in the dignity of the individual and his inalienable right to seek happiness, freedom, and salvation according to his own lights. Perhaps the measure of our success as a nation is the status of the individual man.

My fourth and final common denominator of our American faith is the spiritual unity of our people, which overrides our religious diversity. Running through all our diversities are common ethical and moral strands, originating in large part in our Hebrew-Christian tradition. The tradition that every human being has spiritual importance, that life is sacred, that the golden rule is fundamental, that certain broad principles of morality and justice are natural, that is, universal and unchanging.

If we in America had not been able to reach wide agreement on what is good and what is evil, our civilization might have perished long before this. Winston Churchill, at the M.I.T. Mid-Century Convocation, spoke of the "flame of Christian ethics" as being still our highest guide. He spoke as a student of history who knows that it is because we have remained committed to these moral standards that our culture has survived. Such spiritual unity provides the only framework within which the other attributes of our society are possible. Progress, peaceful adjustment to change, tolerance, and respect for divers opinions and needs, can only coexist where there is a shared conviction that it is man and his needs which give meaning and purpose to the laws and institutions of society. Otherwise, freedom would lead to chaos – as in fact it has in countries where wide consensus on goals is lacking.

We have until recently been able to take it for granted that most of us in this country are acting in good faith to support our common aims based on respect for man. That has been the course of our great progress as a nation. It has been the reason why what we have done on this continent has given hope to man everywhere that men can learn to live in peace without those coercive powers of state that destroy the integrity of individuals.

When Thomas Jefferson penned the lines of the Declaration of Independence, he was not deciding what was right and what was wrong. As he was later to write to his friend Henry Lee of the Declaration: "It was intended to be an expression of the American

mind, and to give to that expression the proper tone and spirit called for by the occasion. All its authority rests, then, on the harmonizing sentiments of the day, whether expressed in conversation, in letters, printed essays or in the elementary books of public right, as Aristotle, Cicero, Locke, Sidney, etc." That the democratic way of life must rest on such "harmonizing sentiments" – on a foundation of common beliefs – if it is to be more than a pious hope, was demonstrated by the experience of France in the Eighteenth Century and of the post-World War I democracies in Europe in our own day.

These shared convictions, these bonds of unity, which I have so roughly sketched need more than ever to be stressed today when we face the regimented doctrines of communism and the hazard of disunity created by our efforts to combat communism's conspiratorial tactics. Our great strength lies in a proud, self-confident commitment to our own unifying philosophy, and to an articulate, vehement advocacy of our ideals. Walt Whitman long ago called the cue:

> Long, too long America,
> Traveling roads all even and peaceful you learn'd from joys and prosperity only,
> But now, ah now, to learn from crises of anguish, advancing, grappling with direst fate and recoiling not,
> And now to conceive and show to the world what your children en-masse really are . . .

This veritably is our cue and not the technique of tearing our unity apart which we have been witnessing recently in Washington. Within the month the Washington *Post* in an eloquent editorial advocating the establishment of a nonpartisan commission on national security, commented on the "rising distrust, the roaring bitterness, the ranging of Americans against Americans, the assault on freedom of inquiry, the intolerance of opposition" in our national capital.

"We know," said this editorial, "that some sincere people claim that we have had these abuses before and have lived through them, as when business and finance were pilloried during the 1930's . . . the class bitterness stirred up by these excesses still hurts our unity . . . the very expression of our political liberty is the opposition that the witch-hunting would stifle . . . the mad-dog quality of McCarthyism has become so apparent that its power for sowing confusion and suspicion has probably spent its force. . . . However, it would be reckless to ignore the circumstances that permitted this . . . aberration to paralyze American diplomacy and to thrust fears and doubts in the minds of our people. The urgent problem is to find a way back to a basic unity, to traditional American standards." So speaks a courageous and conservative representative of our free press.

Other voices, notably Archibald MacLeish's, in a recent speech at Wellesley College, similarly deplore the current violations of the American credo. "Confidence in peace," he said, "confidence in the future, the natural, normal, decent confidence of men of courage and character in their country and in themselves, has all but vanished from the Congress of the United States. And in the prolonged and inexplicable silence of the President there are few voices raised anywhere for what we used to think of as the American cause: the cause of the human future."

These clinical notes, ladies and gentlemen of the graduating class, on a current American malady – a lack of faith in American unity – have led me in talking with you today to appeal for a clarification in your own minds of the true meaning of America and for a rededication to those shared convictions which are the sinews of our strength. Your support of the democratic values of which I have spoken will depend on your own conviction that these values are essential if men are to live and advance together in peace and good fellowship. If democracy and freedom are to survive the present struggle, it will be because the majority of people in the free world continue to believe in the basic concepts which are the heart and soul of democracy.

In the years you have been students in this institution, citizens in this community, you have found all about you evidence of the American outlook and philosophy which I have been describing. Your education and your living here have been shaped by these American concepts while at the same time encompassing the internationalism of science and scholarship. While you have been here, you have witnessed a mounting emphasis on our objective to make this a community where students not only acquire a professional education and learn the responsibilities of mature citizenship in the classroom, but actually practice these responsibilities in their day-to-day living.

You, as a class, have contributed importantly to our progress toward this goal by your responsible conduct and management of student affairs, by your wide-ranging interests, both professional and nonprofessional, and by your readiness to exercise the traditional M.I.T. freedom of expression and freedom to criticize. As evidence, I recall the seismic disturbance caused by an increase in dormitory rentals.

You have also been encouraged to think for yourselves and to think professionally. You have learned that to act without adequate knowledge of the true nature of things is not only foolhardy but dangerous.

(*Concluded on page 550*)

A. Devaney, Inc., N.Y.

Printing—the Mother of Progress

For All Its Contributions to Human Welfare, the Graphic Arts Industry Needs the Invigorating Rejuvenation of Research, Invention, and Reduced Labor Costs

BY ELBRIDGE W. PALMER

SYMPOSIUM ADDRESS

TAKING the major title of the symposium: "Access to Ideas – Is Reading Obsolete" and the subtitle of the section which I am to present: "Printing, the Mother of Progress," I must confess that I evolved that subtitle from the original suggestion, "The Present State of the Printing Industry," presented by William W. Garth, Jr., '36, chairman of this symposium. Should any of those present here today be involved in any branch of the graphic-arts industry, I am certain you will understand that the printing industry, in general, is today in much the same state of unrest, uncertainty, and indecisiveness as is our international diplomatic policy, as viewed from the position of a common citizen!

Yet I hasten to defend and to praise printing, and the entire graphic arts, for its past accomplishments, its current attempts at improving and expanding its technological advances, its potential promises toward a continuation and expansion of its contributions to the fields of education, recreation, and the permanent recording of all the advances in all fields of endeavor for all time. Assuming that the majority of those present today are but vaguely familiar with what we term, in an all-embracing sense "printing" perhaps it would be well to set the stage for the portrayal that is to follow.

The recording and the dissemination of knowledge are as old as man. We have not the time today to restate the laborious progress accomplished by man down through the centuries since the beginning of time. It must suffice to skim hurriedly and very briefly over the centuries until we reach the current stage of development. Dealing, as we are today, with printing, we may best pick up the origin of so-called printing from the historical record. Printing, historically, is one of the oldest arts, it being known that printing from blocks and clay tablets was practiced in China as early as 50 B.C. It is accepted as fact, although still disputed, that prints from wooden blocks appeared in Europe in the Sixth Century, assumedly from China.

The art of printing from movable types, whereby letters and characters of the alphabet might be arranged at will, and the types re-used, instead of laboriously cutting each page or subject as a unit, is of comparatively recent origin; the first claims to this invention in printing being made by the city of Haarlem, Holland, on behalf of one Lourens Janszoon Coster, reputed to have first made types of wood in 1423, and afterward of lead and tin, yet no actual printed productions of Coster have been produced or identified. Johannes Gutenberg is generally credited with the origination of movable types, it being known that he was active in the field of printing as early as 1438, and to have produced many books from movable types in Mainz, his native city, beginning about 1450. To Johann Faust and Peter Schöffer, associates of Gutenberg, is credited the substitution of metallic types cast in plaster molds for the originally cut or carved individual type characters as developed by Gutenberg; Schöffer also originated hard metal punches whereby duplicate type characters could be produced in the exact symmetry of the original design.

Printing "presses," a title denoting a printing shop, are reputed to have been in operation near Rome in 1465; in 1469 in Milan and Venice; in Paris in 1470, and in London in 1474 – the latter under the direction of William Caxton who was notable in after years for his fine printing.

With the development of printing in Italy came the change from the original type styles of the Germans, called Gothic, to the currently called Roman style about 1501, designed by Aldus Manutius of Venice. As might be expected, the early original type styles were close imitations of the hand-written script of that day; fortunately, the calligraphy of that day furnished excellent style models for the type characters, as it did for the style and balance of the printed page or subject. The Gothic-type Bible, with illuminated initials, generally credited to the Mainz plant of Gutenberg in 1455, is still considered one of the finest examples of book production of the past 500 years. Truthfully, it may be said that to Germany, and in later years and in some particulars to Italy in the Fifteenth Century, must be given generous credit for the early progress in printing styles and processes. France, early in the Sixteenth Century, forged into the lead in printing, with progress in that nation becoming decadent as a result of religious upheaval which drove many of the finest French printers into other countries. The Sixteenth Century is notable for the increasing and commendable development of the art of woodcutting or engraving, then the usual type of illustrating medium in books. All the Seventeenth and early part of the Eighteenth Centuries contributed little to the progress in printing. It is true that the names of Baskerville, Caslon, Bodoni, and Didot were identified during this period with the designing of new faces of printing types or in the modification of old ones. It was during this period that refugees from France, such as Plantin, re-established in Antwerp, came to be known for their fine printing, as did Wynkyn de Worde, William Caxton's successor after the latter's death. The beautiful

font of type still carrying the name of its designer, William Caxton, and much employed today, is but another example of the artistry and craftsmanship of that day.

But we must hasten down the historical road. It is of interest to note that the first printing press in the New World was established in 1539 by Juan Pablos in Mexico City; in our own United States in 1638 by Stephen Daye, right here in Cambridge, then close to Harvard College.

As in all industrial development, epochal inventions have greatly influenced the printing industry. The early printer had to design and build, or have constructed for his use, the types, engraved or hand-cut illustration blocks, the frames or "chases" in which he confined (locked) his type forms, the presses in which he achieved the transfer of the type and illustrative impressions to the paper; he had to make his own ink balls or rollers, probably compounded his own inks and adhesives. It is recorded that it was not until early in the Nineteenth Century that, with the advent of the metal hand press and the first flat-bed cylinder press, the printer ceased to be the inventor and producer of equipment and turned his attention more specifically to the production of printed matter. It was late in the Nineteenth Century, perhaps due to the separation of the making or casting of type from the printer and the establishment of type founding as a separate enterprise, that the point system of type measurement was introduced and generally accepted by printers. This system of measurement standardized types on the basis of approximately 72 points to the inch, with a 12-point type body occupying six lines to the inch; one sixth of an inch corresponds to the earlier designation of pica measurement – hence 12-point type is still called pica size.

The invention of paper-folding machines and other bookbinding equipment about the middle of the Nineteenth Century tended to separate the binding of books and pamphlets from the printing shops into binderies. By the beginning of the Twentieth Century, binderies began to separate into edition (quantity) book binderies, pamphlet and specialty binderies, and job shops handling individual and small lot binding and rebinding orders. During the first quarter of the Twentieth Century another specialized binding service was instituted; new books rebound into stronger bindings to withstand for longer periods the "more issuances" of library books.

The first, and obviously experimental, type-composing machines also made their appearance about the middle of the Nineteenth Century, resulting in the Mergenthaler Linotype (line-of-type) or line slug casting mechanism. Next came the Lanston Monotype (individual type character casting mechanism, activated by a paper ribbon perforated on a keyboard in advance of the type-casting step) which closely simulates the former individual hand-set type character. In 1810, Friedrich König, a German, perfected the application of steam power to the printing press; this press continued the flat-bed type form employed in hand presses but the paper was pressed against the type form by means of a revolving cylinder and the ink was automatically rolled over the type form. While the advent of this new printing press did not contribute to an improvement in printing quality, it did make possible production of printed matter in greater volume. Here in America, in 1846, Richard Hoe, an American, presented the first printing press in which the types were affixed by a special locking device in accurate cylindrical position, opposed to the impression cylinder around which the paper passed in effecting the impression. In England, in 1866, appeared the Walter press, the first press in which curved stereotype plates were affixed to the cylinder in the place of the type forms. With the application of steam power to presses, and the development of, first the cylinder type of impression for the printing press, and later the rotary plate cylinder, came increased progress in the development of printing equipment toward greater speeds, increased printing areas, and improved quality. It may be assumed that the development and establishment of newspapers (England is credited with the first weekly in 1622 and the first daily in 1702) contributed much impetus to the development of machine production in the printing field. The necessity for increased speed, capacity, and printing quality in one or more colors definitely acted as a stimulus to printing equipment invention and improvement.

It is feared that we have delved too long and too deeply into the development of the printing industry as we know it today; on the other hand, one cannot properly evaluate the current status of the entire graphic arts industry without reviewing a limited number of the basic beginnings and later developments. One further explanation is also necessary. Such involves the peculiarities and differences between the several printing "processes."

First, a basic definition of "printing"; the simplest and most understandable definition to my mind is this: "Printing is a process for producing multiple copies of an original subject on paper, fabric, metal, foils or other materials by mechanical means whereby the original (in reverse image) surface is inked and the image transferred to the paper or other material by uniformly impressing the full image to the material."

Next, three processes, determined by the printing surface employed, are recognized:

(1) *Relief*, commonly called *letterpress* printing, in which the impression is made from a raised letter or plate surface. This process accounts for the majority volume of printing for all purposes, although planographic and intaglio processes are competing vigorously in all fields at this, the middle of the Twentieth Century.

(2) *Planographic*, commonly called *lithographic* printing, in which a totally different principle is employed; the use of a practically flat surface of polished sensitized stone or synthetic stone, or of flat zinc or aluminum plates, all of which have a certain quality of porousness, and the affinity of the stone or plate to accept the transfer of the type and design images when applied in a greasy ink, while these same images as transferred reject water and accept ink in the process of inking and impressing the images on the paper or other materials; the watered or blank portions of the stone or plate reject all ink applications, leaving only the images to be printed. *Offset lithography* offers a distinct variation in the actual printing process

in that the impression is not made directly from the stone or metal lithographic plate but directly to a prepared rubber blanket, and "offset" or transferred a second time from the rubber blanket to the paper or material used. This variation permits lithographic printing on fairly rough surfaces, as well as smooth and coated papers, and presents a pleasingly smooth and diffused effect to the single and multicolor pictorial reproductions, while retaining desired solidarity to type and other plane-surfaced reproductions, as in relief printing. Usually included with descriptions of planographic printing are: collotype printing, in which a gelatin surface is employed and the image to be transferred varied by exposure to light; and pantone printing, in which portions of the surface not to accept ink are coated with mercury instead of water.

(3) *Intaglio,* commonly called *gravure* printing in which process the plate, either flat or cylindrical, is prepared with the type and illustrative images etched into the plate, below the surface plane. In actual printing, the plate or cylinder is inked over the complete surface and then hand or mechanically wiped; the recessed crevices of the plate accept and hold the ink, and in the making of the impression to the paper or other material the ink is transferred by capillary action, that is, the ink is sucked out of the plate crevices and transferred to the material.

A fourth, and entirely new process made its appearance in 1948: this is titled *xerographic* printing. This process is still in the stage of development for application in the commercial field. It is claimed that this process eliminates the need for intermediate stereotype matrices or chemically etched engravings as employed in relief printing. The image to be reproduced is transferred electronically to a positive charged, sensitized plate, and the plate is developed by a special powder, charged with negative electrons. The powder adheres, in the desired image, to the plate. To obtain a print, paper or other material is laid over the plate and subjected to the electron rays which transfer the powder to the paper or other material. The image is made fast with moderate heat and the entire process requires but 45 seconds. It is further claimed that plates for this xerographic process can be made from a typewriter, using a photoconductive carbon paper, and can be worked in with one of the new typewriter type-composition processes.

Time does not permit exploring the steps employed in the two major processes generally employed in transposing the typed manuscript into either the slug or the individual type character composition preparatory to printing, nor the dozen or more quite new inventions in photomechanical type composing. Mention has already been made of the Linotype slug line and of the Monotype individual type character assembly for printing. Not far from where we gather today, right here in the city of Cambridge, and under the direction of Mr. Garth, there is being assembled today the first prototype machine for effecting type composing with a resulting photomechanical film, from which transfers are readily made to planographic (lithographic) plates, and from which etched magnesium plates are easily, quickly, and inexpensively made for relief (letterpress) printing. It is generally conceded that the slow, laborious, and relatively expensive steps in the process of translating typed manuscript into printed matter, which have continued with little change for many decades, are due for an early and a very epochal change in printing plants over the nation, from the newspaper and magazine plant to the book and commercial printing shop.

Similarly drastic and advanced changes are in the offing for the processes of electrotyping, photoengraving, and especially in the fields of black and multicolor printing. The old flat-bed, two-revolution, reciprocal action single and two-color presses, the old style perfecting presses (those that print both sides of a sheet during one trip through the press), and even the old-type letterpress and lithographic rotaries are being rapidly replaced with the newer styles of rotaries in single and multicolor possibilities, with equal quality results and much higher speeds, many including integral folders which enable the press to deliver the folded signatures ready for binding.

The size and scope of an industry, almost without exception, directly affect the volume and extent of collective and individual plant research continuously undertaken, the extent of the employment of new inventions, new processes, and new materials. The graphic arts industry, generally, despite its considerable size and the vital part it has played for centuries in the advancement of culture, education, and recreation, has been notably lacking in extensive effort in research and invention until the opening of the Twentieth Century. True, more demonstrated progress has been made here in America beginning with the Nineteenth Century and to date, than in the rest of the world as a whole. Research and invention, and the resulting improvements in equipment and processing, have accelerated rapidly in the second quarter of this, the Twentieth Century, and it appears that we will make much greater and still more rapid progress in the next quarter-century.

Just how big and relatively how important is the graphic arts industry among its sister giants of the industrial field in America? Let's glimpse a few statistics from which may be gleaned a quick evaluation.

In 1943, when the War Production Board was charged with the determination of the essentiality of the graphic arts industry as a whole, it was determined (based on the 1939 Census of Manufacturers) that there were then a total of 27,855 printing and publishing plants doing an annual volume of business in excess of $5,000 and a total of 15,003 establishments having an annual volume of less than $5,000. These 42,858 establishments employed a total of 598,963 persons in all capacities, paid out annually a total of $953,500,000 in salaries and wages, used materials costing a total of $1,100,000,000, and marketed products and services valued at an annual total of three and a quarter billions. The over-all industry stood second in rank among the industries of the nation as to number of establishments, and fifth as to value added by manufacture ($1,835,000,000).

Glancing solely at the book publishing and manufacturing industry, as a simple measuring stick for comparison, one finds from the 1947 Census of Manufacturers, that during that year 648 book publishers did a gross business of $464,000,000, selling a total of 277,450,000 hard-bound books, and 209,766,000

pamphlets. It is of interest to observe the types of books sold:

Textbooks – elementary, high school, college and workbooks	139,145,000
Religious books – Bibles, Testaments, books, and hymnals	41,543,000
Technical and professional	17,467,000
Mail order, including book clubs	54,429,000
Subscription books and sets	14,626,000
Trade books – adult 140,414,000; juvenile 53,752,000	194,166,000
Other books and pamphlets	402,290,000

When one also notes that 554 book publishers in 1939 had gross sales of $155,000,000 compared with sales of $464,000,000 in 1947, some idea of the increase in dollar volume, quantities distributed, and other changes are evident. Impressive also is the tonnage of paper consumed by the book industry alone; in 1947 a total of 251,634 tons of paper went into books – equal to 84,000 single 30-ton capacity minimum cars. Being but a lowly bookmaker I did not overlook the reported fact that the publishers manufacturing cost for the mechanical production of those 487 million books was $87,000,000 in round figures, or about 20 per cent of the publishers' gross intake.

Notwithstanding the facts offered with respect to the size and relative standing of the graphic arts in the over-all industrial pattern in this nation, one must consider the somewhat peculiar, long-term handicap of the printing industry. Down through the centuries, certainly until the late Nineteenth and early Twentieth Centuries, printing developed more or less as an art, rather than as an industrial science. The original guild precept of Europe, and especially England, had a definite effect on retarding the more rapid technological development of the printing industry. Hand, or semihand processing continued to be practiced in many plants in particular printing and binding operations long after the increased demands for productive volume gave loud voice to the need for discarding such outmoded procedures. Even as of today, one finds in many specialized shops in this country, and more so in England and on the Continent, a strong aversion or resistance to change. Happily, only dim vestiges of the old order remain and are distinctly apparent in America.

Printing and binding costs have steadily and generously increased down through the years. In 1920, for example, a journeyman bindery machine operator in New York City worked 48 hours per week and his usual weekly stipend was $24. By 1931 that had changed to $48 for male workers and $29 for female workers, both still on a 48-hour week. From 1941 to 1947 alone, according to responsible estimates, the wage-rate pattern increased from 60 to 93 per cent, while the weekly hours of work declined to 40 generally, and in many cities to 37½, 36¼, and even to 35.

With equal or more drastic cost increases in materials, packaging, transportation, rents, advertising, clerical, and other administrative and operative salaries, and the many other cost factors in the writing, editing, publishing, selling, and distributing of newspapers, periodicals, books, pamphlets, and all other forms of the printed or reproduced word and illustration hitting the entrepreneurs responsible for all forms of publishing, "Printing, the Mother of Progress" seems to be in a very bad way today.

Obviously, the publishers of newspapers, periodicals, and other mediums which derive their major income, not from the per unit sales price, but from the more easily adjusted income from advertising, are not nearly as conscious of the steadily advancing wage costs in manufacturing production as are those publishers whole sole income is dependent upon the volume of sales at so-much-per-copy-sold. Such conditions are readily observed by the manufacturers, particularly the competitive bookmakers, whose bread-and-butter business with their book-publisher clientele depends wholly upon an ability to produce within a strictly competitive range or pricing for their services and the materials they furnish. Constantly increasing journeyman wage rates in the newspaper field alone are continuously used as pressures upon the book, commercial, and specialty graphic arts establishments. The actual mechanical costs of such publications as depend upon advertising revenue are much less important to such owners as to the other groups mentioned.

In the face of a seemingly continuous pressure to lower working hours and to increase wages – despite the blocking or lowering of the well-known cost-of-living – and the higher costs of materials and all other factors, it may safely be predicted that the printing and binding fields of the entire graphic arts industry must exercise greater effort in inventing and developing better mechanization in all operations, and especially in every processing and handling step

(*Continued on page 550*)

Photo by Harold M. Lambert

Is Reading Obsolete?

To a Large Extent, the Various New Mediums of Communication Are Complementary Rather than Mutually Exclusive

BY ANDREW HEISKELL

SYMPOSIUM ADDRESS

THE question, "Is reading obsolete?" is being raised by many persons today. Those who ask it, I suspect, are using the phrase in a narrow sense. They are really suggesting that the mass of our population is no longer reading, by which they mean using their eyes for intellectually and orally elevating purposes. As a purveyor of mass journalism, any answer I might give would be suspect. I would like, however, to be permitted to quote two highly reputable authorities on this subject.

The first says: "A multitude of causes unknown to former times are now acting with a combined force to blunt the discriminating powers of the mind, and unfitting it for all voluntary exertion, to reduce it to a state of almost savage torpor. The most effective of these causes are the great national events which are daily taking place, and the increasing accumulation of men in cities, where the uniformity of their occupations produces a craving for extraordinary incidents which the rapid communication of intelligence hourly gratifies." The second authority states: "The faculty of attention has utterly vanished from the general Anglo-Saxon mind, extinguished at its source by big, blatant journalism, the newspaper and the picture magazine; illustrations, loud simplification; prose that is careful to be in the tone of, and with the distinction of, a newspaper or bill-poster advertisement; these, and only these, 'stand a chance.'"

These two eminent witnesses are William Wordsworth writing in 1802 and Henry James writing in 1902. The question is now once again brought into sharp focus by the advent of television. Innumerable surveys "prove" that the man who owns a television set rarely reads, hardly ever goes to the movies, barely glances at magazines, and though he may still buy a few newspapers, he gives them only a cursory once over. Had further questions been asked, I strongly suspect that this poor television set owner would have been shown dying of insomnia and malnutrition because he no longer has time to eat and sleep. What these surveys *do* prove is that the survey experts and most of us are weak on logic and all too easily translate correlation into cause and effect. We say, without hesitation, that if television attendance is increasing while movie attendance is dropping, the former is *ipso facto* the cause of the latter. It was only recently that some genius in the survey field discovered that movie attendance had dropped as much in the areas where television does not exist as it had in cities where there was television.

Since Henry James wrote those doleful words in 1902, the American people have digested the advent of the automobile, the telephone, motion pictures, radio, and scores of less important developments in the field of communication. The people today own 40 million cars, they spend 16 billion hours a year listening to the radio, and buy 4 billion movie tickets a year. Yet, during these 50 years, the circulation of daily papers has gone up over five times, and that of general magazines about 10 times, and the number of books and pamphlets published per year has increased fivefold.

I suggest, therefore, that the only theory which can satisfy these statistics is that the new developments in the field of communication are successful only to the extent that they fill a vacuum. If we go back to 1900 we see a country in which most of the adult male population walked to work. Whether this motion was accompanied by mental activity is unanswerable. However, as soon as the working man took to riding to the plant in a trolley or subway, he found himself wondering what to do with his hands and eyes and perhaps, his mind. The tabloids took care of that problem.

Some years later, his work week was cut down and his earnings increased, thereby creating another vacuum which the automobile filled in part. His wife, having replaced the wood stove with a range, and having bought an icebox, a washing machine, and a vacuum cleaner had spare time on her hands. Today she, nevertheless, continues to complain of being tired in the evening. The reason is not heavy work but the emotional exhaustion resulting from listening consecutively to the trials and tribulations of the heroines of five soap operas.

Until the advent of television there were still plenty of people who would spend the evening smoking a pipe and staring into the distance. But today these persons are watching Colorado's Mountain Man tearing off the ears of Boston's Irish Gargantua in a televised wrestling match.

This increase in leisure time explains, from the quantitative point of view, man's ability to take on so many new forms of activities. In 50 years, man's work week has dropped from 60 to around 38 hours. The new mediums of communication have rippled outward to encompass those persons who, in 1900, were informed by conversation only. As man would no doubt go crazy if he devoted these additional 22 hours of leisure to concentrated thought, it is probably just as well that most of the new vacuums have been filled

with these more or less passive forms of entertainment and information. The only real victim to date of these inventions has been the art of social graces. In 1900, evenings among the relative elite were spent listening to a guest reading Burns, to the young lady of the house singing or playing the piano. Members of the upper-class family had to excel at elocution, card tricks, hypnotism, or palm reading. The working class worked, ate, and slept. Even the better bourgeois did not fare so well, as an excerpt from the Lynds' *Middletown* testifies. Speaking of the wife of one of the city's leading citizens, it says: "A regular sight summer mornings with a friend out in her gig, shelling peas while her horse ambled along the road." Today practically the only form of social interchange that exists is bridge and canasta. They will no doubt capitulate to television.

All of these statistics do not answer the question, "Is reading obsolete?" Quantitatively, it obviously is not. Modern man is devouring an enormous poundage, or perhaps I should say tonnage of printed matter. In fact there is a prevalent theory that if the quantitative curve continues upward at the present rate, our population, half of which now wears glasses, will be blind within 100 years.

But the question that many are asking is, "What does all this mean from a qualitative viewpoint?" One answer to the question would be to examine the "best sellers" list over the years. The first surprising discovery is that from the best estimates available over a period of 280 years the best sellers have consistently been bought by one per cent of the United States population. Specifically, in the late 1600's Bacon's *Essays* sold 1,000 copies; in the middle of the Seventeenth Century Richardson's *Pamela* sold over 10,000 copies, and 100 years later Dickens' *David Copperfield* sold 225,000 copies. In this past decade, best sellers over the 1,300,000 mark were James Hilton's *Random Harvest,* Douglas' *The Robe,* Jan Struther's *Mrs. Miniver,* and four Pocket books including one on *New Adventures of Ellery Queen, The Pocket Book of Boners,* and also *The Pocket Book of Verse.*

The indication here would be that literacy and intellect were synonymous three centuries ago but not today. But then why should one expect the literary intellectual elite to be a constant percentage of the population. A historian wrote recently of Henry James: "A very distinguished author, he enjoyed an immense prestige and suffered from a paucity of readers." This phrase is today equally applicable to Auden.

But to conclude from this that present day mediums of communication are all deficient is erroneous. *Life's* managing editor has on the wall of his office a sign saying: "Never overestimate the reader's knowledge. Never underestimate his intelligence."

The basic error of the critics of the present state of affairs is to assume that if a man has intelligence but no education he is, nevertheless, prepared to enjoy James, Auden, Horizons, Einstein or Toynbee. Our editors know that the only limit to people's interest in any subject is our ability to present it in the frame of reference of the reader's knowledge. Our experience has been that our readers have enjoyed a 10-part, 200-page treatment of the history of Western culture, that they have not been appalled by a 20-page essay on the atom, or a 10-page story on Arnold Toynbee's theories. The combination of an increasingly high educational level and good presentation has given the Sunday *Times* a circulation of more than 1,000,000. While you and I may complain about the tabloids or the comics, let us remember that they are mainly an introduction to reading. If Dr. Killian were to spend all his time on comics and tabloids we might have cause for worry. However, the fact is that most of the readers of these mediums would otherwise read nothing. A small percentage at least graduate each year to better publications. And if you seek further consolation, I should mention that comics which originated with a strip called *Yellow Kid* – from which came the term, yellow journalism – have now developed to the extent that a comic, *Dagwood Splits the Atom,* is a prime educational force in helping people to understand atomic energy. Incidentally, General Electric is using comics to give technical training to their employees.

The question that faces us is not whether reading is obsolete but whether education and its adjuncts, the various mediums of communication, can keep up with the constantly increasing demands that are put upon democratic society. Most of us feel that words are an adequate and respectable method of communication – a method that should satisfy all needs. The fact is there are too many people who need to be educated and informed too rapidly for words to do the job. The various techniques of communication were never more vitally proved out than in World War II when suddenly millions of Americans had to learn to fire an M-1, use a compass, read a map, learn about scouting and patrolling, know how to recognize aircraft. All this education had previously been done with pamphlets – usually 200 pages of small print for each subject. The Army called on us to help, and jointly we put out giant picture portfolios with telling pictures, each visualizing an idea, and terse text explaining the meaning of each picture.

These portfolios, and training films, upped the technical competence of the G.I. while allowing a reduc-

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H. Armstrong Roberts

The Promise of Technology

We See Proof Everywhere that Technology Will Not Fail to Bring Us What We Have the Wisdom and Strength to Strive for

BY LUIS DE FLOREZ

SYMPOSIUM ADDRESS

My assignment in this symposium seems to call for some measure of prophecy concerning the future of printing. If I am unwilling to venture a prediction, however, it is not so much because my experience in the graphic arts is recent and limited, but rather because it seems unwise and unnecessary to speculate with our future efforts when there are better and safer ways of blazing the road to progress.

The promise of technology is always fabulous, but it goes without saying that unless it is intelligently directed toward useful accomplishment, it serves to little purpose. Technology, like Aladdin's genie, is the slave of man, not his master, as some would believe. The problem which really confronts us is not to guess what the future has in store, but to formulate the answer to the question, "What do we want technology to do for us from now on?"

The only sure way to find this answer is neither dramatic nor easy. It is to be found in the result of continuous and systematic research – long-range fundamental studies to provide orientation and objectives, and the more specific study and experiment to develop systems, processes, and equipment to achieve the objectives.

To start from the beginning, Webster tells us that the graphic arts are those "which pertain to the expression of ideas by means of lines, marks, or characters impressed on a surface." We might say that the hand-written letter and the artist's painting are, in a broad sense, examples of the graphic arts, but the industry which we are discussing today is one which has grown up around the idea of mass reproduction and distribution of the creative work of the individual, rather than the production of the original itself. Basically, this is the purpose of the printing press, but we can readily see that printed matter must be put together in some acceptable form for distribution. Consequently, there is a lot to be done besides printing to make it possible for the press itself to serve its purpose.

The graphic arts industry, which concerns itself with all of the steps required to bring printed expression to the individual, is one of our major industries, ranking near the top – not only in economic importance, but in its effects on all of us. It is simple enough to visualize the revolutionary effect of the invention of printing on the world's history, but not always do we realize that its impact on civilization became universal only when its technological development reached the point where mass production and distribution became possible.

In the course of time, the written word and picture have assumed many forms and have been reproduced in many ways by hand and by machine. They have served not only to convey current information and thought, but to stir the emotions, and as a means of perpetuating knowledge. There is no reason to expect that these functions will ever change, but the centuries in which the printed word had no substantial competitor for communication and the distribution of knowledge have come to an end. From now on, the graphic arts must face the formidable and growing competition of radio, television, the motion picture, recorders, and new mechanical devices for teaching and training.

The effect of this competition is already suggested by the figures of the United States Department of Commerce for national income by industry which show that the printing and publishing industry, rated fifth in 1939, now holds ninth place on the same list. We come to the conclusion, therefore that the future position of the industry will depend to an increasing extent on its ability to cope with the competition of other means of expression.

Two courses lie ahead: (1) to accept what appears to be the inevitable and natural course of events, and gradually decline in favor and scope to some stable mediocrity; or (2) to make the effort required to find new and more appealing means of graphic presentation to capture some new segment of popular interest, or at least to recapture some of the ground lost.

It is fair to say that the industry has always striven for better presentation, but it is apparent that efforts in this direction have neither been effectively directed, nor of sufficient magnitude to produce the kind of result the situation calls for. If we are to direct technology to the improvement of printing techniques and set it to work on the creation of processes and machinery to enhance quality and reduce cost, we should first provide a firm base to start from and a hopeful outlook.

At no time in history has there ever been so much knowledge or talent available for basic research of this character, nor greater ability to organize it. It cannot fail if adequate support is provided. The basic research suggested is not within the capabilities of any one man, or even by a number of men with the same background of training and occupation. The philosophy of making printed matter more effective in all its objectives can only be developed by a team composed of specialists in different fields. The psychologist, the advertising man, the publisher, the reader, the author, the educator, and thinkers of still other fields, must be brought together to study new ways of presenting and transferring ideas and knowledge graphically. Their program should disregard all tradi-

tion, and should begin with the basic psychological investigation into the general subjects of comprehension, training, readability, and perception. It would necessarily include the study of characters, format, colors and color contrasts, illustration, and even the study of such devices as strip presentation, which has such strong appeal to the children of every age.

Are the forms of printing in common use today the most effective in conveying information? Are the characters in use, and their disposition on the printed page, designed to give the greatest facility and greatest appeal to the reader? What new forms of printing can be devised to better serve the purpose? Are we training our future readers to best advantage to comprehend printed matter? Questions such as these are perennial and must be reviewed constantly, for the tastes and customs of people will change with the passage of time – sometimes unnoticed until suddenly we become aware of a result.

Tradition has decreed, for instance, that the proper arrangement for the printed word should be in the form of lines of type arranged in such manner that the ends of the printed lines on the page begin and end at straight vertical boundaries. Recent investigation by a group at Tufts College has indicated that printed matter is actually easier to read and comprehend if the lines of print are disposed in such manner that they are centered on a vertical line at the center of a column without reference to the evenness of the edges. A page carrying two such columns of printing is not only preferable to comprehension, but carries as much printed matter as the conventional format. We know that it is now possible to teach children, also adults, to read at extraordinary speeds by training their eyes to grasp the meaning of lines instead of words, and even to comprehend entire paragraphs at a glance.

During World War II we found it possible to teach instant recognition of aircraft by flashing their pictures on a screen, decreasing the intervals of time of the projection until only one hundredth of a second was required for recognition by the average trainee. The combination of new forms of presentation and new methods of educational training deserves profound consideration and continuous long-range study.

We should not expect long-range research to terminate in final answers, but consider it as a continuous exploration which would establish a trend and, from time to time, point to the need for specific developments for adoption by the industry. Neither should we attempt to predict the results of such investigations, but simply admit the possibility of improvement and

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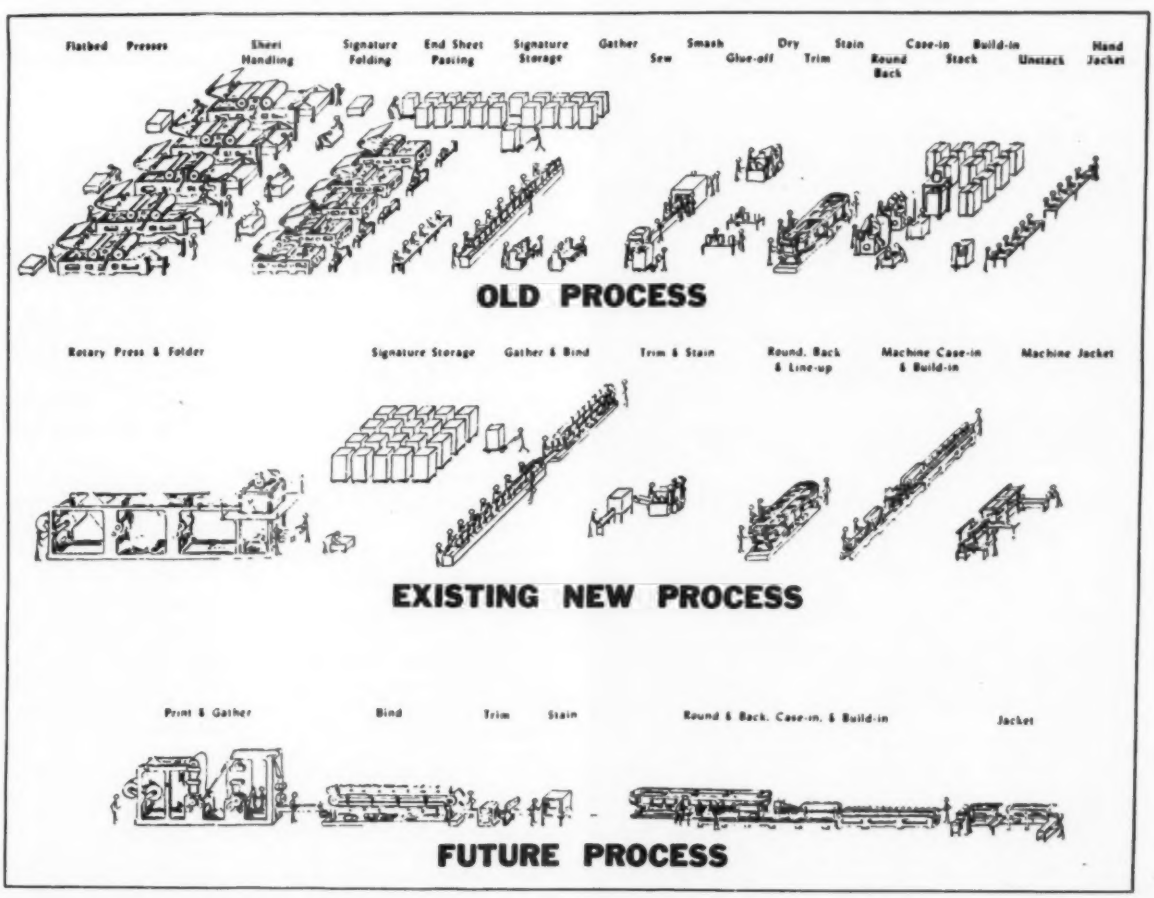


Diagram giving visual impression of the savings of time and personnel which can be made in book manufacturing through full employment of research and invention in this field. The top diagram illustrates old processes of manufacture which can already be greatly simplified, as shown in the center, through improved techniques of folding, gathering, and binding. At the bottom are indicated the possibilities of future processes which almost completely mechanize book manufacturing.

Alumni

In mid-June, during a series of those perfect days about which James Russell Lowell penned his famous lines, M.I.T. awarded degrees to the largest graduating class in its 86-year history, while the Alumni Association celebrated 75 years of continuous and successful operation by scheduling class reunions, a thought-provoking symposium on the graphic arts industry, and a banquet at which progress at Technology and the Development Fund Program were reported respectively by James R. Killian, Jr., '26, President, and Marshall B. Dalton, '15, chairman of the Committee on Financing Development. Interspersed with these main events were many other enjoyable and illuminating activities of, perhaps, more restricted popular appeal, such as the reunions and forums staged by eight departments, the dedication of the Dugald Caleb Jackson Room (recorded on page 522), the President's meeting for Honorary Secretaries, and the admission of a new class to the fold of Technology Alumni. On the basis of merit, each event might well lay claim to primal narration. Since the limitations of the printed page preclude more than one "first," however, the following account is arranged, somewhat arbitrarily but with justifiable logic, in chronological sequence.

Class Day

For the largest graduating class in the Institute's history, Senior Week activities began on Thursday, June 1, with the Senior Ball at Boston's Hotel Somerset. The following day, the Senior Class held an informal dance in Walker Memorial, whereas Sunday was given over to an informal outdoor event.

On Wednesday, June 7, the Senior Stag Banquet was held at 6:30 P.M. at the Rockwell Athletic Cage, at which M.I.T. representatives were: Karl T. Compton, Chairman of the Corporation; James R. Killian, Jr., '26, President, and Everett M. Baker, Dean of Students.

Photographs of the graduates were made in the Great Court at 10:30 A.M. on Thursday, June 8. At the baccalaureate service, Dean Baker read the call to worship and led the prayers, President Killian gave the Scripture reading, and Dr. Compton made the baccalaureate address, "Incentives and Satisfactions," which appears on page 497 of this issue. Philip M. Richardson, '26, played the organ prelude, hymns, processional, and recessional marches using the Class of 1918 electronic organ. Two choral pieces were rendered by the M.I.T. Choir under the direction of Klaus Liepmann, Assistant Professor of Music.

(Top): Life's *publisher, Andrew Heiskell, attempts to answer the query, "Is Reading Obsolete?" at the symposium.* (Center): *Principals in the commencement exercises were* (left to right): *Karl T. Compton, Chester I. Barnard, James R. Killian, Jr., '26 and C. Adrian Sawyer, Jr., '02,* (Bottom): *In his symposium address, Admiral Luis de Florez, '11, tells how technology can benefit the graphic arts, while listeners include* (left to right) *William W. Garth, Jr., '36, symposium chairman, Colonel E. W. Palmer, and Mr. Heiskell, symposium speakers.*

Day, 1950

At 2.00 P.M, graduates and members of their families gathered in Morss Hall, Walker Memorial, for the traditional Class Day exercises in which, in a program in light vein, the graduating class was formally inducted into the M.I.T. Alumni Association. As organist, Dr. Richardson played the opening selections, and Thomas J. McLeer, Jr., '50, chairman of the Senior Week Committee, made the introductory welcoming address. As representative of the 50-year Class, Professor Emeritus George E. Russell,'00, acquainted the audience with some of the early history of the Institute and the conditions of student life of half a century ago. In commenting on the growth of the Institute during the past 50 years, Professor Russell said:

In the 31 years previous to the year that favored the world with the graduating class of 1900, there had been but 2,100 graduates. Tomorrow you will swell this number to more than 33,000.

Likewise the number of names on the lists of the Alumni Association has jumped from around 7,000 to approximately 53,000 – of whom more than 43,000 are living.

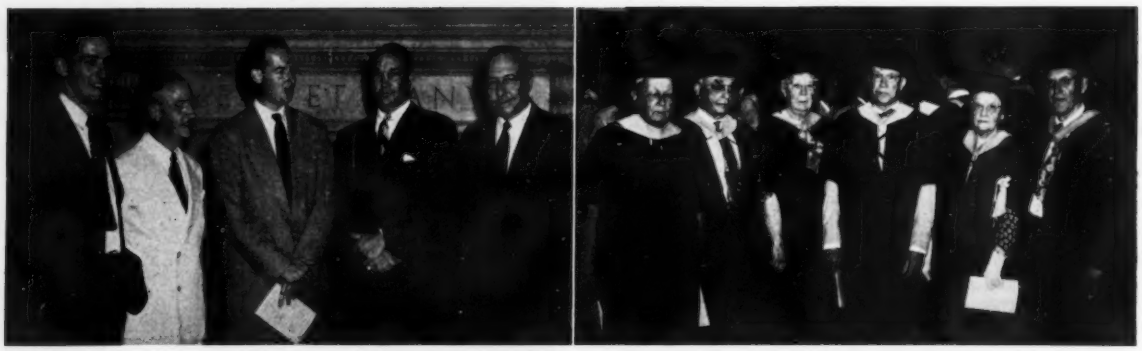
In the same period, the instructing staff increased from 138 to more than 860 – to make no mention of some 365 men engaged in research work.

At the conclusion of the 50-year address, Robert W. Mann, President of the Senior Class, went through the traditional M.I.T. ceremony of transferring the class ring to Arthur A. Wasserman, President of the Class of 1951. The transfer of the large wooden beaver ring symbolizes the passing of authority and responsibility for student government to the new senior class for the coming school year.

Again in the manner of many years gone by, the graduating class applied for admission to the Alumni Association by presenting a humorous skit in which were emphasized the difficulties which the graduates imagined they would face when leaving the Institute and going out into the world. Author of the skit, John T. Weaver, '50, served also as producer and theatrical manager for the dozen or so who participated in *The March in Time* which lampooned radio advertising of the more obnoxious kind.

Upon conclusion of this playlet, C. Adrian Sawyer, Jr., '02, President of the Alumni Association, presented the Class of 1950 banner to Mr. Mann as token of welcome of the new class into the Alumni Association. Richard P. Price, '25, then gave the address of the 25-year Class by surveying general events at the Institute (and throughout the world generally) a quarter of a

(Top): *Robert W. Mann, President of the graduating class, transfers the senior ring to Arthur A. Wasserman, President of the new Senior Class in Class Day ceremonies.* (Top center): *Lunching informally in Du Pont Court are* (in usual reading order): *Lewis E. Moore, Claude E. Patch, William M. Bassett, Arthur L. Collier, Frederick H. Hunter, C. Adrian Sawyer, Jr., and Grant S. Taylor—all members of the Class of 1902.* (Bottom Center): *The registration desk in the Rogers Building was the focal point of interest on Alumni Day.* (Bottom): *General view of the luncheon in Du Pont Court from roof of Building 1 where Alumni Association is housed.*



Assembled for Class Day exercises are (left to right): *Thomas J. McLeer, Jr., chairman, Senior Week Committee; Professor Emeritus Russell, Class Day speaker for 50-year Class; Robert W. Mann, President of the Class of 1950; Richard P. Price, Class Day speaker for 25-year Class; and Mr. Sawyer. More formally, in cap and gown, members of the Class of 1900 who marched in the commencement exercises included* (left to right): *Zenas M. Briggs, Mortimer Silverman, Jane H. Bartlett, Stanley G. H. Fitch, Clara I. Durgin, and Elbert G. Allen, Class Secretary.*

century ago. Speaking for his Class, he warmly welcomed the graduates to the company of M.I.T. Alumni.

Ivan J. Geiger, Director of Athletics, then made the Class of 1948 presentation to the outstanding athlete of the year. The award is made each year "to the member of each graduating class who has best exemplified through athletics those traits of leadership and character which we deem essential to the educational ideals of the Massachusetts Institute of Technology." Based on the qualifications of leadership, character, athletic achievement, and athletic improvement, this year's award went to John H. MacMillan who had won three varsity letters in basketball, three varsity letters in baseball, numerals in the freshman tennis team, numerals in intramural swimming, and concluded his athletic activities as captain of the 1950 baseball team. Honorable mention was given to Robert C. Weber, for crew; John O. Adams, Jr., for track; Donald C. Lea, for hockey and lacrosse; Alphonse J. Dell'Isola, for track; and Edwin A. Corrie, for golf and basketball.

In concluding the Class Day exercises, Joseph S. Gottlieb gave the Beaver Oration which briefly summarized activities of the members of the graduating class during their four years at the Institute.

Commencement

On Friday morning, June 9, more than 5,000 Faculty members, students, and guests filled the Rockwell Athletic Cage to overflowing in witness of the commencement exercises of the largest graduating class in the Institute's history. To the organ accompaniment by Harry U. Camp, '18, Mr. Sawyer led the academic procession of the guests of honor, members of the Class of 1900, officers of the Class of 1925, members of the Faculty, and the graduating class.

The invocation was given by the Most Reverend John J. Wright, Bishop of Worcester. The commencement address (which appears on page 500 of this issue) was given by Chester I. Barnard, President of the Rockefeller Foundation. The oath of office in the Officers' Reserve Corps and the Air Force Reserve was administered by Lieutenant Colonel Burton B. Bruce, '38. As chairman of the Corporation, Dr. Compton made the presentation of 1,257 degrees to 1,225

Celebrating 60 years since their graduation from M.I.T., at near side of table with backs to camera, are (right to left): *Harry B. Burley, Mrs. Harry M. Goodwin, Mrs. Franklin W. White, John L. Batchelder, John G. Crane, Henry W. Clement, Mrs. Grant, Harry L. Grant, '00, Mrs. Newhall, and Charles A. Newhall, '00. At far side of table facing camera are* (right to left): *Charles W. Sherman, George A. Packard, Class Secretary, Frank M. Greenlaw, Willard C. Tilson, Chester V. Carlton, Spaulding Bartlett, Arthur C. Walworth, '00, Sidney E. Horton, and William P. Flint. Those grouped at the right are, in reading order: Steven R. Berke, '16, Joseph S. Ullian, Joseph W. Barker, '16, Mrs. Barker, C. Clinton Carpenter, '16, C. J. Carpenter, and Marshall S. Wellington, '16.*

Women graduates who marched in the commencement procession were (left to right): *Virginia G. Stevens, Dorothy W. Pelzer, Kathleen M. Black, Betty J. Fax, Barbara F. Van Tassel, Mrs. Mary A. S. Davison, (whose degree was awarded in September, 1949), Natalie J. Adelman, and Cecily M. McL. Cannan. At right, President Killian congratulates John M. Rau, Jr., of Chicago, who received three degrees from the Institute at this year's commencement exercises.*

graduates. Major General Frank A. Keating, Commanding General of the New England Subarea, made the presentation of reserve commissions, and President Killian concluded the ceremonies with the farewell address. The Review is happy to be able to bring this important message to its readers on page 503.

During the commencement ceremonies, the following number of degrees was awarded: doctor of philosophy, 49; doctor of science, 39; advanced engineering degrees, 40; master in Architecture, 3; master in City Planning, 11; master of science and bachelor of science, 29; master of science, 184; bachelor in Architecture; 14, bachelor of science, 856. The graduating class included 32 students who received two degrees simultaneously. As the first student in the Institute's history to receive three degrees at the same time, John M. Rau, Jr., of Chicago, won the unusual distinction of receiving the degrees of S.B. and S.M. in Electrical Engineering, and S.B. in Business and Engineering Administration.

On the distaff side the unusual number of eight young ladies marched in the procession to receive M.I.T. degrees as follows: Cecily M. McL. Cannan, Ph.D. in Biology; Mrs. Mary A. S. Davison, Ph.D. in Chemistry, (degree awarded in September, 1949); Betty J. Fax, Ph.D. in Chemistry; Barbara F. Van Tassel, Ph.D. in Chemistry; Dorothy W. Pelzer, master in Architecture; Natalie J. Adelman, S.B. in Building Engineering and Construction; Kathleen M. Black, S.B. in Chemical Engineering; Virginia G. Stevens, bachelor in Architecture.

Meeting of the Honorary Secretaries

The President's annual dinner for Honorary Secretaries and M.I.T. club officers began with a business meeting at 4:30 P.M. on Sunday, June 11, at the Brae Burn Country Club in Newton. As chairman of the meeting, Professor Julius A. Stratton, '23, Provost, called upon various members of the M.I.T. Faculty and staff to discuss means for improving relations with principals and headmasters of preparatory schools, and especially with students in secondary schools who may elect to study at M.I.T. In discussing means of interesting promising students to study at the Institute, Professor B. Alden Thresher, '20, Director of Admissions, made it clear that, although the number of applications for admission has exceeded the number who could be accommodated, there was still a problem of recruiting a sufficient number of young people of such caliber as would benefit most from the Institute's in-

This informal luncheon septet includes (left to right): *Mrs. Bond, Mrs. Pearson, Hugh S. Ferguson, '23 Harold C. Pearson, '23, John A. Lunn, '17, President-elect of the Alumni Association, Mrs. Ferguson, and Horatio L. Bond, '23. At the President's Luncheon for the 50-year Class were* (left side of table, front to rear): *Mrs. Russell, Chester A. Richardson, Levi B. Jennings, Frederick I. Merrick, and Mrs. Merrick; whereas at the right* (front to rear) *are: Professor Emeritus Russell, Frederick D. Lawley, Mrs. Lawley, Mrs. C. Burton Cotting, Theodore W. Brigham, Mrs. Blair, Mrs. Atwood, Robert S. Blair, George D. Atwood, Mrs. Porter, and John L. Porter. Mr. and Mrs. Charles E. Smith are at the far end of the table.*

As usual the Stein-on-the-Table Banquet concluded events of Alumni Day, 1950, and again, as usual, the highly prized souvenir steins were designed by Henry B. Kane, '24. But the locale of the banquet was the Copley Plaza where 800 Alumni gave many a rousing cheer. Seated at the banquet table, in usual order, are: Hugh S. Ferguson, '23, Professor Emeritus George E. Russell, John A. Lunn, '17, Rudolf F. Haffenreffer, '95, Andrew Heiskell, Charles E. Smith, '00, Thomas C. Desmond, '09, Karl T. Compton, and C. Adrian Sawyer, Jr., '02.

struction. Thomas P. Pitre, Dean of Freshmen, acquainted the Honorary Secretaries with the Institute's policy of awarding freshman scholarships which annually account for approximately half of all endowment return available for M.I.T. scholarships. In addition to substantial scholarship aid to freshmen, those students who achieve a satisfactory scholastic standing may qualify for scholarship aid or loans in the later years, thereby reducing the cost of an M.I.T. education.

Speaking of student life at the Institute, Dean Baker stated that Technology is rapidly becoming a place where all the students who choose to do so may be able to live in dormitories adjacent to the Technology buildings. As a further indication of the well-rounded activities which the Institute provides to its student body, it was recalled that the M.I.T. athletic program now engages approximately two thirds of the student body as active participants in intramural or varsity sports — a state of affairs achieved by few colleges in the United States. Dean Baker also outlined a plan now under study for assisting students to earn some of the costs of tuition and living expenses during their student days.

At this point, the meeting was opened for discussion by the 50 or 60 secretaries in attendance, and many local problems of student recruiting, student scholarships, and relations with heads of preparatory schools were discussed.

In concluding this portion of the meeting, H. E. Lobdell, '17, Executive Vice-president of the Alumni Association, spoke on student-alumni relations and emphasized the role which M.I.T. Alumni had played in funding M.I.T.'s independence for the 10-year period during which the Alumni Fund has been in operation.

After a most enjoyable dinner with congenial companions, President Killian spoke in review of developments currently taking place at the Institute. For the most part, the essence of President Killian's remarks is included in the news items and reports in various sections of this issue of The Review. He called upon Dr. Compton, who, since Alumni Day, 1949, has returned to the Institute full time as chairman of the Corporation. Mr. Dalton gave the representatives assembled a preview of the status of the Development Program which was publicly announced at the banquet on Alumni Day the following day, and which is reported below under the heading of Alumni Banquet.

In a report on one of the outstanding developments of the past year, Professor Ronald H. Robnett of the Department of Business and Engineering Administration, reviewed the work of the Committee on Educa-

Young in spirit were graduates of some six decades ago. In clockwise order, beginning with man having arm on next chair, are: Frank W. Howard, '91, John L. Damon, '91, Harry J. Carlson, '92, Professor Emeritus Charles E. Fuller, '92, Leonard B. Buchanan, '93, Fred E. Ellis, '88, Arthur T. Chase, '86, Samuel S. Dearborn, '84, and Harry H. Young, '91. At the right, Toastmaster Desmond beams approvingly as certificate of honorary membership in the Alumni Association is awarded to John W. M. Bunker, Dean of the Graduate School.

At the President's Luncheon for the 50-year Class, the head table included, in reading order: James R. Killian, Jr., '26, Karl T. Compton, Mrs. Killian, Stanley G. H. Fitch, '00, Donald P. Severance, '38, Mrs. Fitch, Herbert R. Stearns, '00, Mrs. Ingersoll Bowditch, and Charles E. Smith, '00.

tional Survey whose report, it is hoped, will soon be available for general distribution. In summarizing the studies which the Faculty committee of five has been conducting for two and a half years, Professor Robnett called attention to the Institute's need for student housing in the vicinity of the Institute's academic buildings – a need which is being rapidly met – and to the program of supplementing the students' technical training by subjects in the humanities to provide a more rounded education. The Institute is also giving increased attention to its undergraduate curriculum, and its Faculty has appointed a Committee on Undergraduate Policy with full responsibility for co-ordinating the work previously done by several groups dealing with specialized phases of the bachelor's program. Professor Walter G. Whitman, '17, Head of the Department of Chemical Engineering, reviewed the work now in progress by the new Committee on Undergraduate Policy of which he is chairman. This committee was established late in the spring by a vote of the Faculty (in conformity with the recommendation of the Committee on Educational Survey) to provide an integrated survey for all undergraduate studies, and has had half a dozen fruitful discussion meetings already.

After these reports from members of the Institute family, general discussion was participated in by Frank F. Bell, '10; William J. Sherry, '21; Lauren B. Hitchcock, '20; Harry P. Field, '21, and Walter T. Spalding, '10, representing the M.I.T. Club of Hawaii.

Alumni Day

On a bright day of perfect summer weather, approximately 1,000 Alumni returned to the Institute to take part in Alumni Day activities on the Institute campus and the Stein-on-the-Table Banquet at the Copley Plaza in Boston. Registration was held from 9:00 A.M. to 12:00 M. in the Rogers Building, and from 10:30 until noontime reunions and forums were held by the Departments of Aeronautical Engineering, Biology, Business and Engineering Administration, Chemical Engineering, Chemistry, Civil and Sanitary Engineering, Electrical Engineering, and Mechanical Engineering.

Between 12:30 and 2:00 P.M., a buffet-style luncheon was held in Du Pont Court at tables seating from four to eight persons. Under canvas, President Killian held luncheon for members of the Classes of 1890 and 1900, celebrating their 60th and 50th reunions, respectively. The class of 1910 also had special tables, in honor of their 40th reunion.

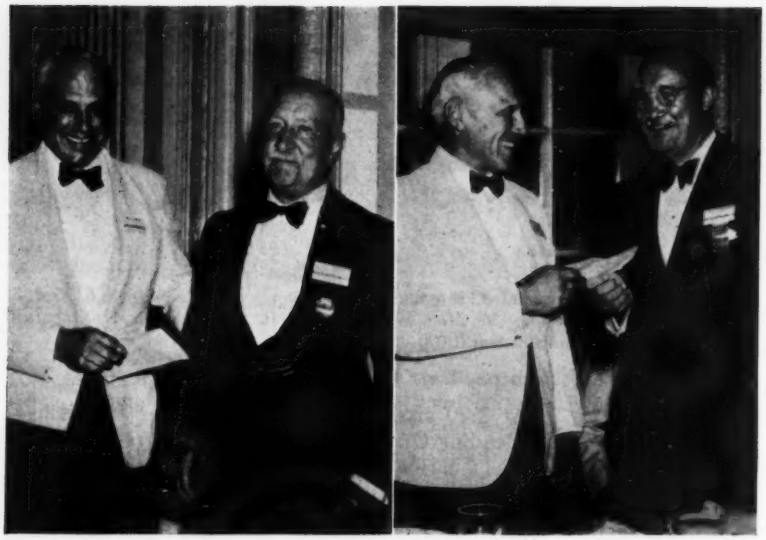
Symposium

At 2:30 P.M., the symposium, "Access to Ideas – Is Reading Obsolete?" was held in the recently completed Charles Hayden Memorial Library. Vernon D. Tate, Director of Libraries, welcomed the guests to the Institute's latest educational building, and William W. Garth, Jr., '36, symposium chairman, introduced the symposium speakers: Colonel Elbridge W. Palmer, Andrew Heiskell, and Admiral Luis de Florez, '11. The thoughts expressed during the symposium are recorded as feature articles on pages 506, 510, and 512 of this issue of The Review.

Between 4:00 and 5:30 P.M., President and Mrs. Killian welcomed Alumni at the President's House, after which many classes held predinner gatherings at the Copley Plaza between 5:30 and 6:30.

In keeping with the theme of this symposium, "A Technology Book Shelf, 1868 to Date" was on display in the halls of the Hayden Library. Shown were about 200 volumes on a wide variety of topics – all of which were written, or in a few cases edited or illustrated, by M.I.T. graduates. The selection represented volumes from standard technical textbooks to works on electricity for boys, a perpetual calendar, travel, biography, stamp collecting, early American furniture, and even the manufacture of sausages.

Around the table in clockwise order are: Mrs. Fuller, Floid M. Fuller, '06, Edward B. Rowe, '06, standing and talking with Horace S. Ford, M.I.T. Treasurer, and James W. Kidder, '06, Class Secretary.



Karl T. Compton, chairman of the M.I.T. Corporation, receives Class gifts from Charles E. Smith, '00, (left) *and from Richard P. Price, '25,* (right) *during an important moment of the Alumni Day Banquet.*

Alumni Banquet

Inaugurating a change from the practice of many years past, the Alumni Banquet this year was held at the Copley Plaza. Approximately 800 were present in the main ballroom, whereas about 70 wives attended the Ladies' Banquet in the Sheraton Room at the same hotel. The Technology stein, which each dinner guest received, was designed by Henry B. Kane, '24, Director of the Alumni Fund. Harry U. Camp, '18, and Orville B. Denison, '11, were organist and song master, respectively, in some of the less serious moments of the evening's events. Mr. Sawyer was the presiding officer and Thomas C. Desmond, '09, was master of ceremonies. For the 25-year Class, Richard P. Price, '25, presented his class gift of $86,000 to Dr. Compton, and for the 50-year Class, Charles E. Smith, '00, made a presentation of a packet of checks and securities in excess of $25,000. Both of these handsome gifts were accepted graciously by Dr. Compton.

John W. M. Bunker, Dean of the Graduate School, and a member of the Institute's Faculty since 1921, was then conducted to the speakers' table by Donald P. Severance, '38, Secretary and Treasurer of the Association, to receive a certificate attesting to his recent election to honorary membership in the M.I.T. Alumni Association. Thus was a 1909 Alumnus of Brown University inducted into the lusty family of Technology graduates, many of whom he had taught, or had later guided through the Graduate School.

In reporting progress during the past year by the Committee on Financing Development, Mr. Dalton announced that in the last fiscal year the program had raised $8,500,000 – bringing the grand total in the $20,000,000 program to $13,650,000. When this announcement was made, three additional gifts of $1,000 each were announced by the Class of 1925.

The final major item on the program was the annual report to the Alumni by President Killian recorded below, slightly condensed.

President's Report

A normal state of self-dissatisfaction best describes the temper of the Institute in the year 1950. Self-dissatisfaction underlies the Institute's dynamic quality, its restless seeking for new solutions, the sense of movement, of goals to be attained, and of a destiny ahead which permeates the staff and the student body. Along with this sense of dissatisfaction and movement, however, goes a sense of stability and assurance. In commenting upon our New Dormitory, one of the architectural magazines observed that "only an institution as self-assured as M.I.T." would have parted so drastically from the conventional and the stereotyped.

Tonight I would like to give some illustrations of how these two forces, the force of change and the force of stability, shape our program. I want to start by talking about people, and I want to start talking about people by talking about Karl T. Compton, chairman of the Corporation. The event of the year was his happy triumph over illness and his return to the Institute full time. Better than perhaps anyone else, I can testify to the reassurance we all feel now that we again have the uninterrupted benefit of his vigor and leadership.

Scholarship

In talking about people I also want to talk about students. We have 5,000 of them, hailing from all over the nation and all over the world. I doubt if you could find a more cosmopolitan group of students anywhere in the world, or a more exciting and challenging group of young people with whom to work. That they are a versatile and winning group is shown by the records. Of the total of 96 Rhodes scholars selected throughout the country this spring, two were selected from M.I.T.'s student body. Twelve of our students this spring received Fulbright awards for study abroad, an exceptionally high percentage of the number who applied, we understand from the committee on selection. Among the 85 students from all over the world selected this year for Rotary International Fellowships, M.I.T. had its representative.

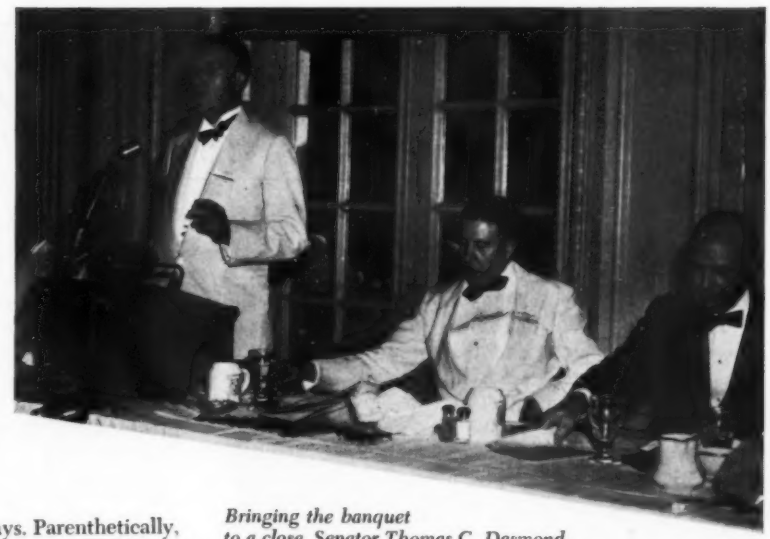
Recently I received a report from the Association of American Medical Colleges giving the standing of our graduates in the qualification examinations given on a national basis for admission to American medical schools. The standings of students from 365 colleges and universities were reported upon, these being the institutions that had 15 or more graduates to take the national examinations. Some 22 men who had had their premedical training at M.I.T. took the examinations. M.I.T. stood in the first two institutions in the competitive standing of its students in premedical training; it stood in the first three in the standing of its students in general educational preparation. These first two standings were not altogether surprising, but the third one was. In understanding modern society, our students stood within the first three institutions of the country.

This fine competitive showing reflects the high quality of work done in our Biology Department, where premedical students get their training, and on the effectiveness of the Institute's undergraduate professional program as a

program in general education. This is a very reassuring result, because the Institute is giving increased attention, as I shall explain later, to broadening the base of its educational program and to making sure that we give our undergraduates a well rounded education.

Athletics

If our students do well in scholastic competition, they are showing themselves to be no slouches in athletic competition. You may have heard that this spring we won a crew race. In fact, we won the Eastern Sprint Championship against the largest number of crews ever to compete in this event. We won it with a crew that averaged in height six feet four and three quarters inches, evidence enough that we grow them tall these days. Parenthetically, you will be interested to know that only one member of this varsity crew was a senior, so that we have a pretty good reason to believe that we will have a good crew next year. Crew is not the only sport in which our students did well during the year. In the Millrose games in New York our mile relay team defeated Princeton, Harvard, and Yale; our sailors several weeks ago won the Eastern Dinghy Crown; and our rifle team, the New England Championship.



Bringing the banquet to a close, Senator Thomas C. Desmond, '09, toastmaster, expresses thanks to all who, in the words of the popular Technology song, made Alumni Day, 1950, "a mem'ry that will never die." President Killian and Marshall B. Dalton, '15, are at the right.

Students and Faculty

How will M.I.T.'s graduates fare this year? I am happy to report that already two thirds of our graduates are either placed or are going on for graduate study. We expect by fall that most of them will be placed. This is a remarkable record considering the over-all national situation.

Except for the temporary imbalance caused by the swollen G.I. classes, the long-term outlook is favorable. The engineering profession is now the largest profession for men in the United States, being exceeded only by the teaching and nursing professions. A recent study by the Bureau of Labor Statistics indicates that a further steady growth in this profession may be expected over the next decade.

While statistics are no way to measure scholarly achievement, it is interesting to observe that some 900 books and scientific papers were published by members of our Faculty and Administration during the academic year reported on in the last President's Report.

During the year Professor Bruno B. Rossi of the Physics Department and Julius A. Stratton, '23, our Provost were elected to membership in the National Academy of Sciences, bringing to a total of 14 the number of our Faculty and Administration who have received this, the most distinguished honor available to American scientists. Many other honors, awards, recognitions, and fellowships came to members of the staff this year – more than enough to certify the high level of accomplishment and prestige of our Faculty, one of the outstanding company of great scholars and great teachers in the world, the foundation of M.I.T.'s greatness.

Educational Survey

Aside from its high output in scholarship research, and teaching, the Faculty also has been giving an abnormal amount of attention to this normal state of self-dissatisfaction of which I spoke. The most important academic event of the year at the Institute was the presentation of the report of the Faculty Committee on Educational Survey, which has come to be affectionately known as the Lewis Committee because Professor Emeritus Warren K. Lewis, '05, of the Department of Chemical Engineering was its chairman. This report, which will shortly be given public distribution, is a milestone in the development of the Institute's educational philosophy, and a distinguished contribution to educational thought which, I am sure, will have a profound effect on engineering education in the United States.

Most notably the report drives home the opportunity which M.I.T. has to still further strengthen its undergraduate education in order that the Institute may turn out men better qualified to deal with the current problems of society. The committee recommended ways, subsequently adopted by the Faculty, in which the organization of our Faculty could be strengthened for the purpose of achieving better educational supervision and integration of our undergraduate curriculum. The committee urged that we move in the direction of more flexibility, that we improve our subjects of instruction by reduction of detailed content and by increased emphasis upon fundamental principles, and upon the development of powers of judgment and discrimination by the students in the formulation and application of these principles. It suggested a variety of ways in which we can further improve our teaching techniques, and it outlined many ways in which we can provide an environment contributing to the intellectual unity and the morale of our Faculty. And finally, the report recommended that we give increasing importance to the humanities and the social sciences in our program. "It is M.I.T.'s duty," says the report, "to prepare its students for social responsibility and for a rich and complete life. But, important though these objectives may be, technological and social problems are now so inextricably woven that the humanities and social sciences are also essential components of a man's professional education. Without an adequate cultural background, a technical specialist is no longer qualified for leadership in his own field."

I am particularly happy about the emphasis which the committee placed upon a strong and advancing undergraduate program. We have not made as much progress

(*Continued on page 526*)

THE INSTITUTE GAZETTE

PREPARED IN COLLABORATION WITH THE TECHNOLOGY NEWS SERVICE

Dugald Caleb Jackson Room

On Sunday afternoon, June 11, as part of the events of commencement and Alumni Day, the Dugald Caleb Jackson Room was dedicated at a tea and ceremony attended by more than 50 members of Professor Jackson's family, friends, former students, and staff associates of the Department of Electrical Engineering. The program, which was transmitted by wire to Professor Jackson at his home in Cambridge, was opened by John G. Trump, '33, Associate Professor of Electrical Engineering, who introduced the speakers.

On behalf of M.I.T., Edward L. Moreland, '07, who retired in June as Executive Vice-president of the Institute, presented the attractive Dugald Caleb Jackson Room. He stressed the importance of Professor Jackson's contribution to engineering and engineering education, pointing out that from his graduation in 1885 to now, he had witnessed and been a part of almost the entire growth of the electrical industry as we know it today.

Professor Harold L. Hazen, '24, accepted the Dugald Caleb Jackson Room on behalf of the Department. Speaking of his former chief, Professor Hazen said:

> He valued as of first importance a faculty deeply devoted to the training of young people in the creative spirit of engineering, and a faculty who are known and respected nationally and internationally for their professional accomplishments. . . . On behalf of my colleagues and I who have had the rich experience of working with Professor Jackson, who have profited immeasurably by his wise counsel and patient guidance, and who have long since developed a deep and abiding affection for him and his lifelong helpmate and partner – need I name her? – I wish to pay a grateful tribute to him to whom we dedicate this room.

A poem by Catharine Jackson Alger, daughter of Professor and Mrs. Jackson, entitled, *We Inherit from the Universe,* was read by Mrs. David Prince, granddaughter.

Joseph W. Barker, '16, a close friend of Professor Jackson for many years, gave the dedication address which he opened by recalling a few of the many pleasant personal relations he had had with Professor Jackson as teacher, colleague, and friend since 1912. In opening his comments, Dr. Barker said:

> It is peculiarly appropriate that this Seminar Room of the Department should be dedicated to Professor Jackson. He was the moving spirit and instigating force behind the many educational features of the Department which will use this room – graduate seminars, honors groups, colloquia to mention only a few. I hope also that it will become the custom to hold the departmental staff meetings here so that future generations of staff may draw inspiration and guidance by figuratively "sitting at his feet."

Speaking of the leadership that Professor Jackson had exerted during his 27 years as Head of the Department, Dr. Barker pointed out that Professor Jackson's former students now included: four deans of engineering schools; 29 executive officers of departments; 82 professors of electrical engineering; two past presidents, six vice-presidents, and two directors of the American Institute of Electrical Engineers; 21 presidents of companies, 16 company vice-presidents, and 27 chief engineers. Professor Barker's address closed with the tribute:

> Dugald Caleb Jackson, by virtue of the authority vested in me by the 2,800 graduates of your Department I confirm to you the loving admiration of all your students in whose hearts you will live as the embodiment of the professional and personal ideal and confer upon you all the rights and privileges thereunto appertaining.

Although Professor Jackson was not able to attend these ceremonies in person, he was represented by members of his family, including, Mrs. Jackson, Philip L. Alger, '15, and Mrs. Alger, Mr. and Mrs. David C. Prince, Jr., Dugald C. Jackson, Jr., '21, and Dugald C. Jackson, 3d, '40. Among the distinguished guests who were present was William F. Ryan, Vice-president of Stone and Webster, Inc., with members of his family. Mr. Ryan has been closely associated with Professor Jackson throughout the years, and has been an active partner in formulating "The Faith of the Engineer" with Professor Jackson for the Engineers' Council for Professional Development. Approximately 25 senior members of the staff of the Department of Electrical Engineering and their wives also attended the ceremonies.

The Dugald Caleb Jackson Room is decorated in modern motif, adjoins the headquarters of the Electrical Engineering Department on the Great Court, and will be used for seminars, conferences, and special meetings of the Department. Acknowledgment was made to the firm of Jackson and Moreland, and to the Institute for this room.

Distinguished Visitor

His Excellency Liaquat Ali Khan, Prime Minister of Pakistan, and his Begum, Liaquat Ali, were guests of the Institute on May 26. The Prime Minister was accompanied by His Excellency M. A. H. Ispahani, Pakistan Ambassador to Washington, the Honorable M. Ikramullah, Foreign Secretary of Pakistan, and other representatives of Pakistan, as well as by officials of the State Department.

The Prime Minister and a number of his party were the guests of James R. Killian, Jr., '26, President of M.I.T., and Mrs. Killian at the President's House. They visited various laboratories at the Institute, and the Prime Minister addressed students and Faculty on "Pakistan, a New Country in the Modern World."

Goodwin Teaching Awards

THE awards honoring the memory of Harry M. Goodwin, '90, whose distinguished association with M.I.T. culminated with his service as dean of its Graduate School, have been announced by John W. M. Bunker, the present Dean of the Graduate School. Established by gift of Dr. Goodwin's widow, Mary B. Goodwin of Brookline, and their son Professor Richard H. Goodwin of Connecticut College, the awards have been established to encourage graduate student achievement in contributions to teaching.

The Goodwin Medal will be awarded in recognition of conspicuously effective teaching of a junior staff member who is also a graduate student. It will be accompanied by a cash prize up to $1,000. The Goodwin Premium consists of a citation and cash prize up to $500 to a graduate student whose thesis presents conspicuously meritorious original research which embodies striking originality, ingenuity, and convincing presentation of a contribution to knowledge. Both awards will not be made in any one year and neither will be conferred if outstanding performance has not been conspicuously effective over and above ordinary excellence. The award is in keeping with the Administration's desire to improve quality of teaching, as evidenced by the lectures on pedagogy begun last fall.

The bases for the awards are unusual in that they do not comprise a competition in which even winning performance might be merely creditable. The Goodwin medalists will constitute a select group of unusually able young teachers. The recipients of the Goodwin Premium will be an equally exceptional small number of those who have contributed importantly to the subject matter for teaching in a degree over and above ordinary expectancy.

Edwin S. Webster: 1867–1950

THE date May 10, 1950, marks the death of Edwin S. Webster, '88, in the annals of the Institute. A member of the Executive Committee of the Corporation and a founder (with his classmate, the late Charles A. Stone) of the engineering firm of Stone and Webster, Inc., he had spent 65 of his 82 years in close association with the Institute and in the field of electrical engineering.

Mr. Webster, the son of Frank G. and Mary M. Webster, was born in Boston on August 26, 1867. A graduate of the Course in Electrical Engineering, he received the degree of B.S. from the Institute in 1888, and was the recipient of an LL.D. from Northeastern University in 1936.

Only one year had elapsed after his graduation from M.I.T. when he and Mr. Stone organized Stone and Webster – the first firm in the country to operate exclusively as engineering consultants. Although in the beginning their activities were mostly in the field of electrical engineering, particularly concerned with public utilities, in later years the partners expanded their services to include general design, engineering, and construction. Stone and Webster furnished supervisory services to public utilities, as well as to industrial companies. The firm also established an investment banking business.

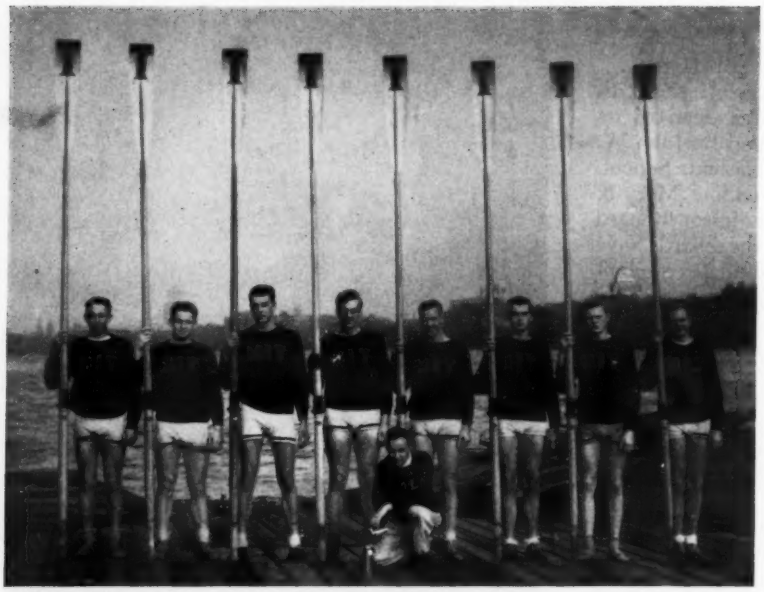
Edwin S. Webster, '88

Member of the M.I.T. Executive Committee

In 1909, Mr. Webster served as president of the M.I.T. Alumni Association. He became a term member of the Corporation of the Institute in 1910, and five years later was elected to life membership on the Corporation. In addition to personal services donated to the Institute through membership on various committees, in 1935 he was one of a group of industrial executives (Research Associates of M.I.T.) who contributed financial support to important research.

To Stone and Webster were entrusted the design and construction of the New Technology in Cambridge, when M.I.T. was moved from its Boston site to the Charles River location, and the particular personal contribution of these two partners was the President's House – a unit which might well be considered the visible evidence of the beginnings of the humanities at this engineering and scientific school because such a structure presented opportunity for students and academic colleagues to see the human side of their leader in a home environment.

Mr. Webster was president of Stone and Webster, Inc. for many years. He became vice-chairman of the firm in 1930 and when Mr. Stone died in 1941 served as chairman of the board. Upon his retirement in 1946, Mr. Webster continued as director in many subsidiary companies. Among his professional societies are included the American Institute of Electrical Engineers and the Boston Society of Civil Engineers; among his social clubs, the Union, St. Botolph, and Engineers. Mr. Webster was a trustee of the Boston Museum of Fine Arts, and for 13 years was president of the Massachusetts Horticultural Society. From 1938 until his death, he was president of the M.I.T. Class of 1888. Mr. Webster is survived by his wife, the former Jane de Peyster Hovey, and three children.



M.I.T. Photo

May 13 was a memorable day in M.I.T. crew history for it brought a very frustrated Beaver crew a definite upset win over favored Harvard. The Beavers had twice failed to nip the vaunted Harvard boat in previous races on the Charles, and in both instances the margin of defeat was a matter of inches. Proving to be good travelers, and vowing not to be denied the third attempt, the Engineers stroked to a win over the East's top crews at the Annapolis Eastern Rowing Championships. M.I.T. won over Harvard in another photofinish, but close as it was, the Technology crew now reigns supreme as Eastern Rowing champions.

Those in the varsity boat were (left to right): *Allen B. Fonda, '51, Forest C. Monkman, '51, Robert C. Weber, '50, Richard D. Semple, '52, Paul G. Smith, '51, John C. Casson, '52, Donald A. Christensen, '52, Alexander W. Urling, Jr., '52, and Donald E. McGuire, '50, coxswain, kneeling in front.*

THE PROMISE OF TECHNOLOGY

(Continued from page 513)

go ahead. Research of this fundamental character, which will result in the selection of common goals, must be undertaken on some sort of co-operative basis, since the printing industry is composed for the most part of a great number of small concerns, no one of which is likely to be financially able to support such a sweeping long-range investigation. Therefore, it is incumbent on the industry as a whole, possibly through the various trade associations, to make joint sponsorships possible.

Joint sponsorships should also encompass fundamental study of the raw materials used by the industry, such as paper and inks, and even adhesives, since basic improvement of such materials can lead to radical changes in production methods and costs. Although the responsibility for the development of these materials lies theoretically outside the industry, their influence on the industry is so great that closely integrated research is essential in striving for better printing techniques.

It is just as important for an industry to invest in research to plan and safeguard its future as it is for its manufacturers to set up depreciation accounts for their machinery. Concepts and methods have a way of becoming just as obsolete as machinery, with the inexorable march of time, and must be changed or replaced to keep pace with a constantly changing world. With the guidance provided by long-range research and an increasing knowledge of the nature and possibilities of materials, the technical skill and experience which we already have will allow us to proceed safely with the application of technology to develop new techniques required, and their adaptation to current manufacture.

The production of printed matter in quantity, in whatever form it may be produced – even including its shipment and distribution to the public – is essentially a process. To achieve efficient operation, we must view the process as a whole, constantly keeping in mind the ultimate purpose of the operation if we would simplify procedure and avoid difficult mechanical problems. We should reserve the option of regrouping, modifying, changing, and eliminating steps.

The improvement in individual machines is essential as one of the steps on the road to progress, but we must not let our interest and enthusiasm for specific mechanisms be construed, necessarily, as the equivalent to improving the process itself. It is essential to evaluate the performance of a machine in terms of its effect on the process as a whole, and not solely with relation to improvement of some individual step.

The importance of this point of view was evident repeatedly in the development of a new and certainly unconventional process to make a conventional hard case book which I, and my associates, completed a year ago. We had for an objective the construction of what might be called an essembly line to manufacture 80,000 books per day, and to strive for a reduction in labor of 50 per cent over conventional operation. That we achieved this goal, and more, bears witness to the effectiveness of the engineering approach, for none of us had ever had previous experience with book manufacture.

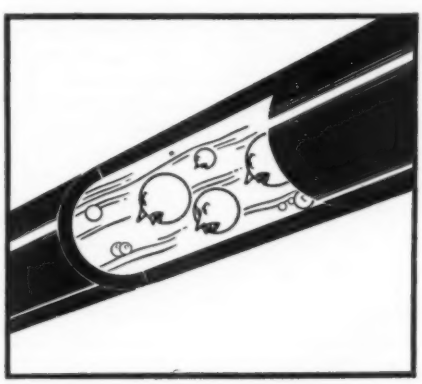
We realized early in the planning that, if radical simplification ever was going to be possible, we had to eliminate the traditional method of binding pages by sewing together the printed matter folded into signatures. No improvement in sewing machines, which have already been perfected to a high degree, or conveying machinery, could ever reduce labor to the extent which would make the project attractive. The Gordian knot was cut by the substitution of a binding method whereby the individual pages are joined together with a plastic film applied and cured in a continuous binding machine. This change in process permitted the regrouping of steps and elimination of enough hand operation to achieve the objective and

(Continued on page 544)

BUSINESS IN MOTION

To our Colleagues in American Business . . .

● Quite a number of years ago Revere coined the phrase "Bubbles have teeth." This refers to the fact that what is called air entrainment is highly damaging to condenser tubes. Bubbles carried along with the cooling water set up a strong disturbance in it, disrupting the film that should protect the metal, and actually seeming to eat away the tube. The oxygen contained in the air bubbles also is destructive. Fortunately, the effects of air entrainment on condenser tubes are sufficiently distinctive to permit Revere Research to detect the trouble by examination of short lengths cut from tubes that have failed before their time.



Thus it happens that every once in a while the Research Department in Rome, New York, working through the Technical Advisory Service, is able to say that there is air leaking into a condenser it has never seen, in a far-off state. The problem then is to seal the water system against the entrance of air. This is not always an easy task, and it is one that the Revere Technical Advisory Service is glad to tackle together with the customer if asked to do so. After all, we want our condenser tubes to last as long as possible; that's what makes customers happy, and builds and preserves our reputation as producers of fine tubes.

In one such instance of bubble trouble, the operator, a public utility, could find no visible sign of a leak. Checking and tightening every bolt and seal produced no results. Finally it was decided to put plate glass windows in some of the inspection plates, in order to see what was going on inside. This located the defect, a stream of bubbles being easily seen pouring out of a gasket. The water was flowing past that gasket with sufficient velocity to suck air in, and was moving too fast to leak out.

In another instance, a few samples of failed tubes from an oil refinery (located almost 3,000 miles away from the utility) were sent to Revere's Research Department. The refiner was told that his trouble was due to bubbles. Again, a check of the condenser showed nothing. The water inlet and outlet lines and all gaskets and bolts seemed to be perfectly tight. Here was another puzzler. But once again it seemed plausible to assume that air was being drawn in where water velocity was high enough to create a suction. The search finally went all the way back to the water pumping station, where two cracked castings were located. Air sucked in through two tiny cracks was enough to do a lot of damage; bubbles do indeed have teeth.

You can see that Revere wants its customers to be satisfied, and to that end sometimes goes to great lengths to look into conditions for which it may be in no way responsible. This attitude is typical of American business; every company rightly regards the satisfied customer as a precious asset, the source of orders that support the business and its employees. Therefore it is suggested that if any product you buy for use in your business is not completely satisfactory, let the supplier know, even if you are sure the trouble is not his fault. He will be glad to cooperate with you in a search for satisfaction.

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26 Lanesville Terrace, Forest Hills, Boston 31, Mass.

ALUMNI DAY, 1950

(*Continued from page 521*)

in recent years in this country in undergraduate teaching as we have in graduate teaching, and the time has come to give special attention again to this part of our program. At M.I.T., where pioneering contributions have been made to undergraduate education, we have a tradition and a responsibility to live up to. The Faculty and Administration are in accord that we must have superlatively good undergraduate teaching, the best that can be found. . . .

In well-chosen remarks, President Killian then paid warm tribute to the long and faithful service rendered by Edward L. Moreland, '07, Executive Vice-president, and Horace S. Ford, Treasurer, both of whom retire from regularly assigned M.I.T. activities at the end of the school year, and continued with a discussion of the Development Program.

Development Program

And now I want to discuss various aspects of the M.I.T. Development Program which Marshall B. Dalton, '15, chairman of the Committee on Financing Development, did not touch upon in his report to you. The first is to pay tribute with all the affection and admiration that I can muster to Marshall Dalton, himself. I speak with unreserved enthusiasm and appreciation for what he has done and for what Alfred P. Sloan, Jr., '95, honorary chairman, has done in directing this great program for the Institute, not only because they themselves have contributed unsparingly and magnificently, but because they typify the contributions and leadership, time, imagination, and hard work, which hundreds of other M.I.T. Alumni have given. The success of this program and the assurance we have that it is going to be fully completed, is testimony to the extraordinary loyalty and high purpose of M.I.T. Alumni. How favored we are as an institution that we can command this kind of effective and public-spirited support! And here I wish also to pay tribute to C. Adrian Sawyer, Jr., '02, the retiring President of your Alumni Association. He has staunchly and effectively worked to strengthen M.I.T., to marshal all its Alumni in loyal brotherhood. . . .

As a result of our Development Program we now have in process of construction and in the planning stage nearly $4,000,000 of new construction, all a part of our Development Plan. The Hydrodynamics Laboratory and Towing Tank is now practically complete. The 12-million volt electrostatic generator will be completed this fall. Plans are now out for bids on the Alfred P. Sloan Metals Processing Laboratory, and designs are being drawn for the John Thompson Dorrance Laboratories of Biology and Food Technology.

One of the most important additions to our facilities during the year, again made possible through the Development Program, was the purchase of the Riverside Apartment Hotel on Memorial Drive. We will start this summer converting this building to a dormitory that will ultimately house 600 students. This, together with our New Dormitory which was finished last year, gives us within a year nearly 1,000 new accommodations for students and brings us closer to our objective of having M.I.T. a residential college. When the Riverside Apartments are in full use as a dormitory, we will be housing approximately two thirds of our student body, including the temporary barracks, Westgate, Westgate West, and the fraternity houses. . . .

And so with your help and the help of the Institute's many friends, we are moving steadily ahead toward clearly established goals. I believe that in the years ahead we may

(*Concluded on page 528*)

Cold Enough to Freeze . . . the Resistance Out of Metals

When temperatures drop low enough . . . say 450 degrees below zero . . . bouncing molecules come to a virtual standstill, eliminating resistance to the flow of electricity so that current will flow indefinitely—even after the power supply has been cut off.

The illustration shows this phenomenon being demonstrated. A circuit has been submerged in liquid helium at a temperature of 452 degrees below zero. The demonstrator . . . Dr. Aaron Wexler . . . has "pulled the plug", disconnecting the circuit. The needle on the upper scale reads zero—no current is entering the circuit.

Yet, the indicator on the recorder below shows that 7,000 amperes are flowing through a cylinder of niobium.

So we have a phenomenon . . . one of the dividends from pure research that is constantly under way with Westinghouse. This particular result of research may lead, for example, to new and better methods of electric power transmission, to mention only one possible application.

Such research into the behavior of matter, particularly metals, at super-cold temperatures, is typical throughout the history of Westinghouse . . . it demonstrates one reason for the dynamic force of American industry . . . it suggests why Westinghouse can live with such a strong statement as . . .

G-10102

YOU CAN BE SURE..IF IT'S Westinghouse

ALUMNI DAY, 1950

(*Concluded from page 526*)

expect from science and engineering a swelling stream of new concepts, new ideas, new products, and new processes which will improve our health, prolong our life, raise our standard of living, and open new vistas to man's spirit. A new age is within our reach if we can but continue this kind of productivity for which the Institute stands, but I believe, too, that we will do this only if we associate with the advances in science a comparable advance in the techniques of using scientific results humanely. M.I.T. as a great center of science and engineering must not neglect this latter aspect while it forges ahead in the development of science. We must be sure that we are not only producing ideas and things, but that we are also educating men, the most effective and well-rounded and responsible men that we know how to train. I have cited evidence of the success that we are meeting in training men who are prepared to accept the full obligations of citizenship. I want to assure you further that we propose to continue to do this, that we believe that the most effective scientists and engineers are not only masters of their fields, but also socially responsible men with a sense of the first-rate in every aspect of their lives. This is the kind of men we seek to train at M.I.T.

All photographs in the Alumni Day article are by the M.I.T. Photographic Service, with the exception of that of Mr. Heiskell at top of page 514 and the general view of Du Pont Court at bottom of page 515, which represent the work of Robert Astra, '52.

SKILL, KNOWLEDGE, JUDGMENT

(*Continued from page 502*)

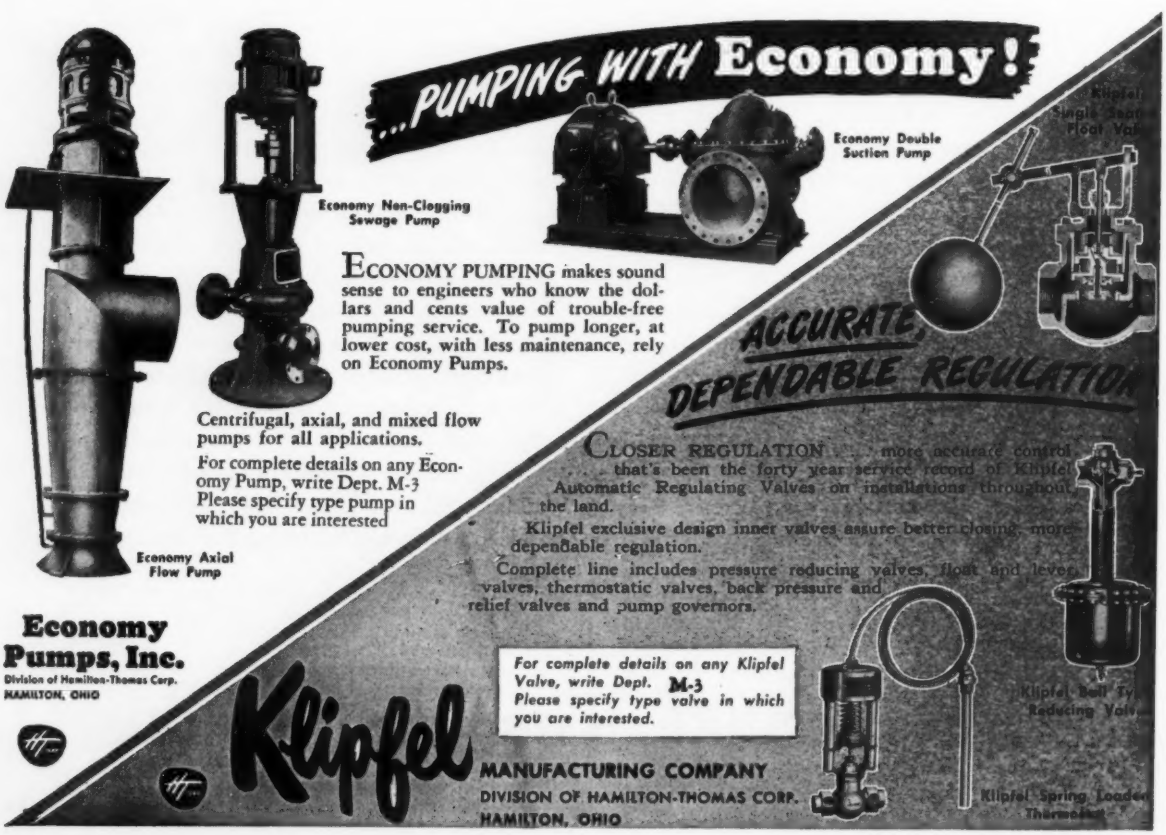
work aimed at acquiring it is one of the most significant aspects of a total education.

If we were to liken human competence to a single structure composed of a number of elements, I think that the pyramid would be a helpful representation. At the base there would be the ordinary and the specialized bodily skills, and then would come the particularized, personal knowledge essential to responsible behavior. Still higher we could place the professional knowledge and intellectual techniques acquired in school. But intellectual equipment is by no means the apex of the pyramid. That supreme position, I believe, must be reserved for judgment.

Judgment

Just what is meant by the word "judgment"? The faculty of judgment is vague, hard to pin down and analyze. There are no criteria for determining in advance what is good or bad judgment, so that acquiring good judgment is not a matter of hard and fast rational procedure. Perhaps we can say that judgment is concerned with decisions or solutions of problems when there is not sufficient factual evidence to warrant a conclusion or where the facts are subject to more than one interpretation. Judgment in that sense

(*Continued on page 530*)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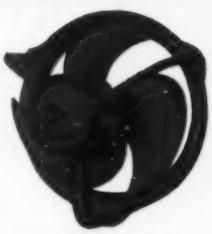

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SKILL, KNOWLEDGE, JUDGMENT

(*Continued from page 528*)

can then be considered as making the most of whatever facts are available.

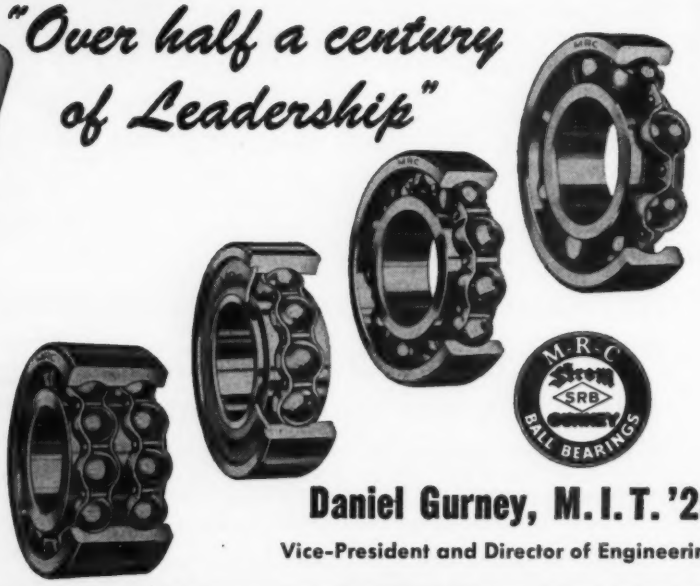
To go strictly by the evidence is the only respectable course in answering scientific questions. Where adequate evidence is not available, the best judgment may be not to answer at all. But this may not be possible. There may be no choice about it. In scientific laboratories, no less than throughout most of our personal affairs, in the practice of the professions, in business management, and in public administration, question after question must be answered regardless of the state of the evidence on the subject. Sometimes it is debatable where the evidence points, sometimes there is not any evidence at all, and sometimes we do not even know what would actually constitute sufficient and valid evidence. And yet a decision is required. Because, *not* to answer might in itself provide an undesired answer by registering as a pocket veto. Furthermore, not answering does not successfully evade insistent questions. Here, then, is where we must call in judgment to assess the facts, or lack of them, in the light of all our other skills, knowledge, and past experience.

We often find ourselves hobbled by the uncertainties of ignorance, working against the unknown, and even the unknowable. When and whom to marry, how and where to educate our children, what to do when

(*Continued on page 532*)

M-R-C BALL BEARINGS

"Over half a century of Leadership"



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Vice-President and Director of Engineering

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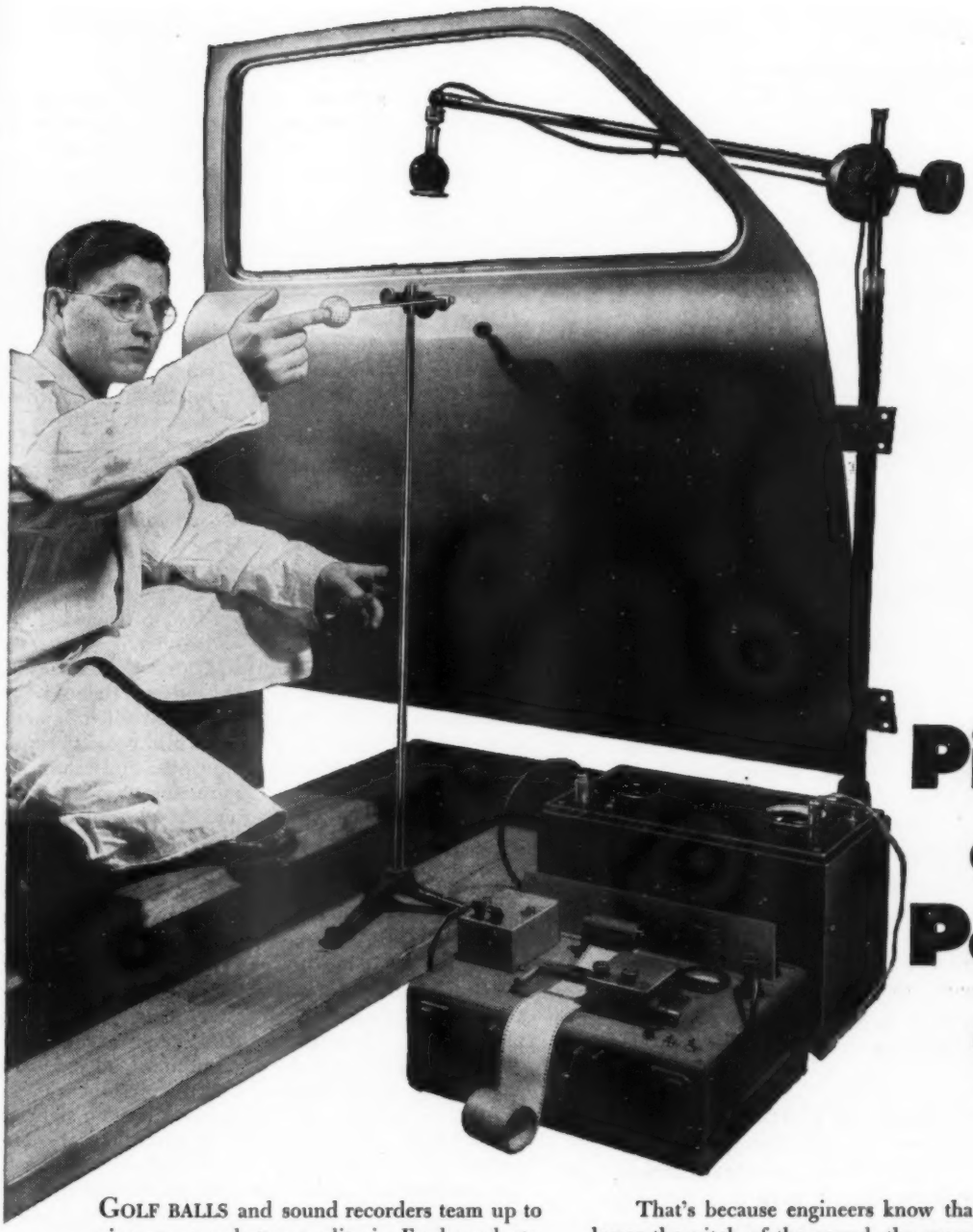

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That's because engineers know that, as a rule, the lower the pitch of the sound, the more pleasing it is to the human ear. And when a sound defies elimination—as some do—then it is the job of the sound technicians, the metallurgists, the fabric men and many other specialists to "gang up" on the noisy noise and change it into a pleasant, solid, reassuring sound, rich and deep with quality. For, in motor cars, quiet is the word for quality and...

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1 Hevi Duty Precision Electric Heat Treating furnaces are built in a large variety of types and sizes — for many heat treating operations — with temperature ranges to 2500° F (1371°C). They are standard production equipment in many national industrial plants.

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SKILL, KNOWLEDGE, JUDGMENT

(Continued from page 530)

confronted by sickness, whether or not to take a specific job, what and where to buy, when and whom to promote, what variable to alter in the next experiment —all these are examples of questions that cannot be answered by calculation alone, that must receive careful judgment. We are not yet in a position to escape the necessity of acting on the basis of judgment. Knowledge and intellectual skills, used in proper prospective, may facilitate judgment; they cannot replace it.

The hard facts of life must be squarely faced. Where we know what we want but have no substantial body of fact to guide us in obtaining it, an informed guess is often to be preferred to no guess at all. In dealing with established goals, experience and wisdom often carry the day, especially when time presses and some action must be taken. The willingness and the ability to exercise judgment in time of need, like the awareness of immediate situations, is inseparable from the concept of responsibility. Anyone can bet on a sure thing. But few are both capable of expert judgment and ready to run the risks of decision.

So much for the necessity of judgment in matters of means to establish ends. What of the ends themselves? It seems to me that the greatest need for judgment relates to the formulating of aims and goals because they involve determination of purpose and establishment of values. And here it is precisely that our skills and our knowledge are hardest to put to use. Cold reason connot predominate here.

What shall I do with my life; what is the good life for me; what is the good life for all men? These are questions which underlie all our other ineluctable questions. The answers are, and it is right that they should be, judgments coming from the heart or from the deepest depths of our experience, though the elusive consensus of the values of our fellowmen of course plays a part in these judgments. We may argue much about our goals, and should continue to do so, and although we must strive to bring reason to bear upon the determination of goals, we must not lose sight of the fact that where our hopes and aspirations are concerned, the decisions are really beyond argument. Our conclusions in the realm of goals transcend our reasons. This is no cause for consternation or dismay. It should be a source of faith and enthusiasm. Our

(Concluded on page 534)

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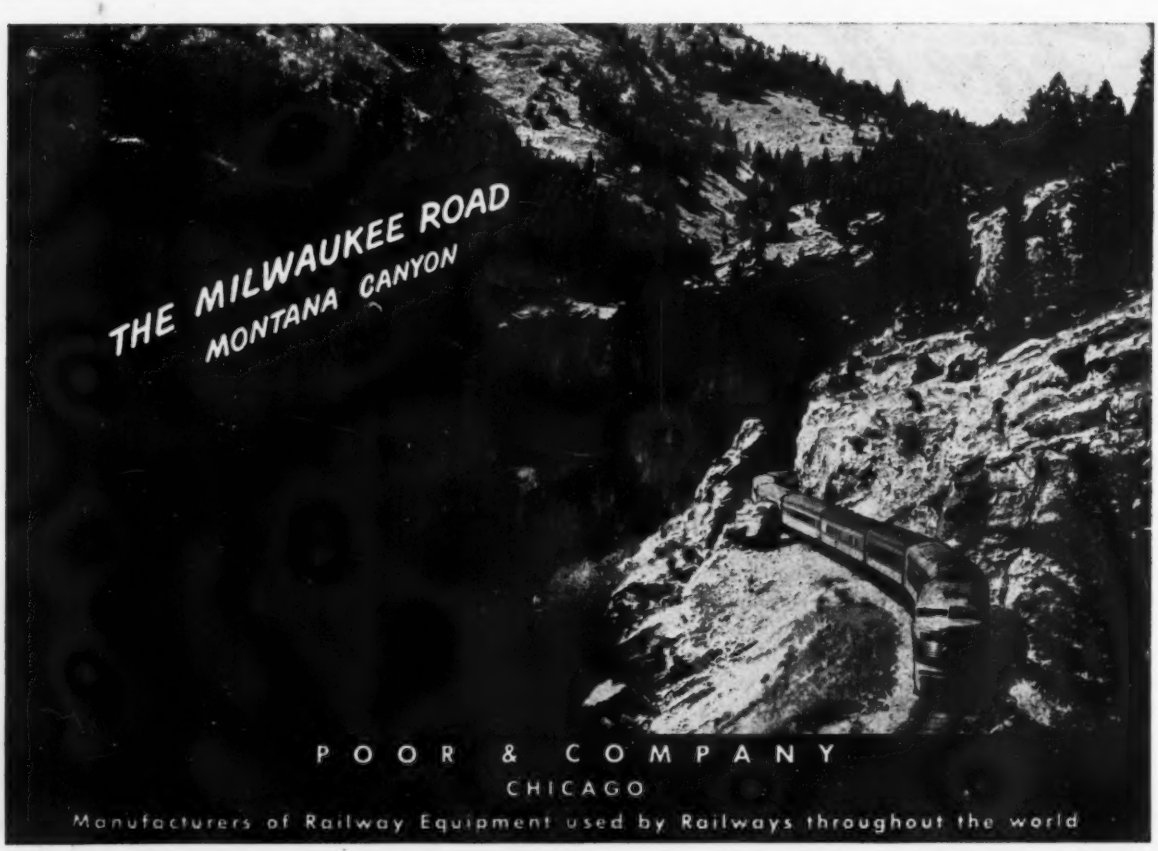
SKILL, KNOWLEDGE, JUDGMENT

(Concluded from page 532)

powers of imagination make it inescapable that we should not rest content with the goals of today, but should press forward, creating new hopes, new dreams, new values. This is the very core of humanity; this it is that lifts us above the level of the animals to a plane a little lower than the angels.

This gift is not without cost to us. For the ideals and aspirations which outrun our earthbound powers we pay a price in frustration. But do not regard frustration, disappointment, or failure as abnormal or unusual or unnatural for human beings. It is a hard, but not unworthy, price to pay. And it is , moreover, true that our highest ambitions and our loftiest moral judgments most easily fall prey to frustration. But we relinquish them at our grave peril. For they are precisely what gives meaning to all our skills, our efforts, our knowledge, and our lives.

A stern doctrine? Yes, but could we convince ourselves that we would change it, even if it were in our power to do so? This great institution, and others like it, and our vast society with its wealth of material resources do not derive from utilitarian ambitions, although these serve a valuable purpose. Our society and everything within it that endures would never have been established except for the moral judgments that through the centuries gave meaning to man's striving for material progress. In such judgments lies the justification for the privileges of thought and action which we so highly prize.



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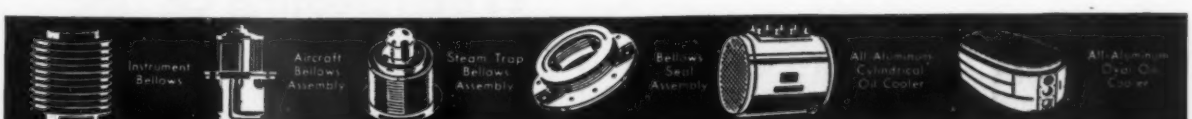

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INCENTIVES AND SATISFACTIONS

(*Continued from page 499*)

ment of critical spirit, and a sense of relevance, sincerity, integrity, exercise of the right to live vigorously and in freedom. I am, however, at liberty to quote from my own contribution to this publication. Thinking of the obligations of "the next voter" I said:

> I have been much impressed by the importance of voting and acting on issues with reference to the over-all values to the nation or to society, as distinct from the advantages to some local or special interest group. We quite properly decry self-interest in a person as his driving motive. We do not so generally deprecate the pressure group seeking its own interest, whether this be a labor union, an industrial concern, a chamber of commerce, or a community. I believe that loyalities to such groups have a legitimate place, but that too often these loyalties tend to prevail over what might be called the "general good." A relatively few men in public life rise above both personal selfishness and local self-interest, and it is these men who become real statesmen. I believe, therefore, that one good objective for the next voter is to identify and to support those causes and those political leaders who are devoted to the general good and are not dominated by special interests.

Apparently when I wrote this paragraph a number of weeks ago I had in the back of my mind the same general thought which underlies my talk to you today. But voting is just one aspect, though an important aspect, of the duties of a citizen. His first duty is to be the right kind of a citizen. When the right kind of a citizen has an important decision to make, his decision will be in the direction of what is sometimes called inclusively the "general good." His decision will be determined by a sense of loyalty and duty, by desire to do something creative and useful, by determination to devote his talents and his efforts to some work which will be of benefit to others, letting the benefit to himself take second place and trusting in the right outcome.

I think it has been evident from my remarks that I have given a very broad interpretation to the phrase in the text, "the kingdom of God and his righteousness." I have used this as a symbol for those objectives which are worthy, and constructive, and primarily unselfish. Let me bring this discourse to a conclusion by coming back to the consideration of your objective in coming to M.I.T. and the way in which you may proceed with this objective from this point on.

(*Concluded on page 538*)

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INCENTIVES AND SATISFACTIONS

(*Concluded from page 536*)

I once saw, written on the blackboard of a classroom, the following statement: "The purpose of a college education is not to enable you to earn your daily bread but to make each mouthful sweeter." There always seemed to me to be several fallacies in that statement. One of them was that it overlooked the fact that the satisfaction in earning one's daily bread may be the very factor which most sweetens it. Another fallacy, I have thought, is that it emphasized the self-satisfaction to be gained by the education rather than the opportunity which may be gained to do a useful and constructive job in life.

Actually, a sound education must have an admixture of many ingredients. One of these ingredients is the one about which our program is centered at M.I.T., namely, a professional education by which the student is prepared to enter a constructive career. Another ingredient is the analytical and disciplinary training which comes from the study of any subject, whether it be in science, engineering, architecture, or literature, or philosophy. Still another ingredient, and a very important one, is the gaining of an appreciation of the thoughts and aspirations of other people and the problems confronting our human society. These things and many others are the ingredients which in various proportions in different institutions, and with different instructors, and for different students, go into the educational program. Out of this program come young men and women who have some degree of preparation to meet the opportunities and the problems of the life which is ahead. We emphasize the training of the mind but we must never forget that it is not the mind alone which controls human action but that it is a great and complicated admixture of knowledge and cold analysis, on the one hand, and warm ambitions, prejudices and passions, on the other, and that out of this admixture there is in some way welded the character which provides the major incentive of life.

On this point Woodrow Wilson, though a great lover of scholarship, had the following to say:

> We speak of this age as an age when mind is monarch, but I take it for granted that if that is true, mind is one of those monarchs who reigns but does not govern. As a matter of fact, the world is governed in every generation by a great House of Commons made up of the passions; and we can only be careful to see that the handsome passions are in the majority.†

Whether we call them passions, or objectives, or ideals, or incentives, our great problem is to make every effort to see that it is what Woodrow Wilson called the "handsome passions," and what I have called the nobler incentives, which prevail in the determination of our actions and our careers. "Seek ye first the kingdom of God, and his righteousness: and all these things shall be added unto you."

† Howard Lowry, *The Mind's Adventure*, page 34 (Philadelphia: Westminster Press, 1950), $2.50.

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IS READING OBSOLETE?

(*Continued from page 511*)

tion in training time. Essentially, they reduced the problem, whatever it was, to a few understandable concepts. Our accomplishment was far from miraculous and, in fact, reminds me somewhat of a quote attributed to Boss Tweed in connection with the anti-Tweed cartoons in *Harper's*. "I don't care a straw for your newspaper articles," he said, "my constituents don't know how to read, but they can't help seeing them damned pictures!"

It seems to me that if you have something to say that needs saying to any man, woman, or child in America, something that requires quick understanding, that can be said and registered despite the competition of all the rest of life's many daily pressures — the best way to do it is with pictures. Movies, television, picture magazines prove this to be a fact, both in their successes and failures. For example, when newsreels, having worn out their novelty appeal, continued to be produced without *saying* anything, they failed. This occurred long before television came into our spectrum. Quite possibly movies are today suffering the fate of not saying enough to satisfy the public. I suspect that radio, despite its fantastic Hooper ratings, also was the victim of the same fate before the advent of television. And in the long run, television is going to have to learn that substance is a necessary prerequisite to any successful form of communication. The American people are growing up rapidly and are prepared to devour immense amounts of news, information and, yes, even culture. They may wish to receive it the easy way, and just what is wrong with the easy way? Why not use short, punchy phrases, pictures, diagrams, if they give more people a desire and ability to learn about a certain subject? Henry Steele Commager whose recent book, *The American Mind*,* is a great success, said that the Eighteenth Century title to the same book would have been *Prolegomenon to an Interpretation of Some Aspects of American Thought and Character from the Eighteen Eighties to the Nineteen Forties.*

The critics of visual methods of education are also the same people who deplore the cultural lag and the low level of knowledge on the part of the public. Do these critics think that wordy prose in small type is going to overcome this problem? As George N. Shuster, President of Hunter College, says: "The character of popular mass culture is henceforth bound to be influenced primarily by what people look at. Where the many critics of our visual age are wrong is that they fail to distinguish between a medium of communication and its content. Basically, there is nothing wrong with our media; after all the windows of Chartres Cathedral were 'visual aids.' Progress depends not so much on the vehicle but on the direction we take and how far we see ahead."

In my opinion, the various new mediums of communication are not a threat to printed matter. On the contrary, they are all, to a large extent, complementary rather than mutually exclusive. Each in its way

(*Continued on page 542*)

* New Haven: Yale University Press, 1950, $5.00.

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IS READING OBSOLETE?

(*Continued from page 540*)

and in its particular appeal to a certain class of society is stimulating the interest of the people along different lines and in different ways. To the average person each new interest makes him that much more receptive to further information and knowledge. As each American, thanks to education and these mediums, climbs the cultural scale, he becomes both a more valuable citizen and a better customer for these very mediums. The best measure of this state of affairs is that the habitual book reader also reads more magazines, sees more movies, looks at more newspapers than nonbook readers. He does not spend as much time on the radio, though he does listen more to public discussions that are broadcast.

Personally, I welcome the newer forms of communication for two reasons. They will, on the one hand, help educate the people and, in these days of trial for democracy, the slow ways of small print, the devious phrase and the literary discussion by the *avant garde* are no longer adequate. Our 150,000,000 people can only be good democrats if communications furnish the flow of information that will allow the people to make up their minds and stand united against the dangers that threaten freedom.

In this connection, I would like to quote from a very fine speech made recently by radio's Henry Morgan to a group of reporters, columnists, editors, and publishers. He said:

"Because of you people in this room I believe Owen Lattimore is a Communist. I also believe he is not a communist. Because of you people I believe F.D.R. was a genius and also that he ruined the country. I believe that there is more crime in this country than ever before and that our police are the best in the world. I believe that Eisenhower would make a great President except that I have read that military men don't make good Presidents and besides he will run if enough pressure is brought, he will not run, he can't run, he refuses to run, he doesn't want the job, you can talk him into it, he's trying very hard to make it look as though he doesn't want it, he's happy at Columbia, he's miserable, he's got a cold, he feels great.

You have made it possible for me to take five cents and buy, in one package, a new picture of President Truman, my horoscope for the day, fifteen comic strips and the stock market reports. And I've read some terrible things about you. You work for money. Advertising dictates your policy. The department stores dictate your editorials. Don't you think you'd be happier with some other system? Wouldn't it be nicer to have a bureau of some kind supervise your work? Then, if the bureau didn't like it, you could adjust or get killed.

Still in all, it's better than having people point at you and say: "There's a man who works for money." Somehow it's getting to be very un-American to work for money. It's also un-American not to work and to live on unemployment insurance. It's un-American to have social security and it's un-American to have such a small amount of social security. I strongly suspect that this is all your fault.

In short, you people in this room have put me, the average man, in a peculiar position. I now have to make up my mind for myself. As long as you keep doing that, as long as you keep forcing the man in the street to make up

(*Concluded on page 544*)

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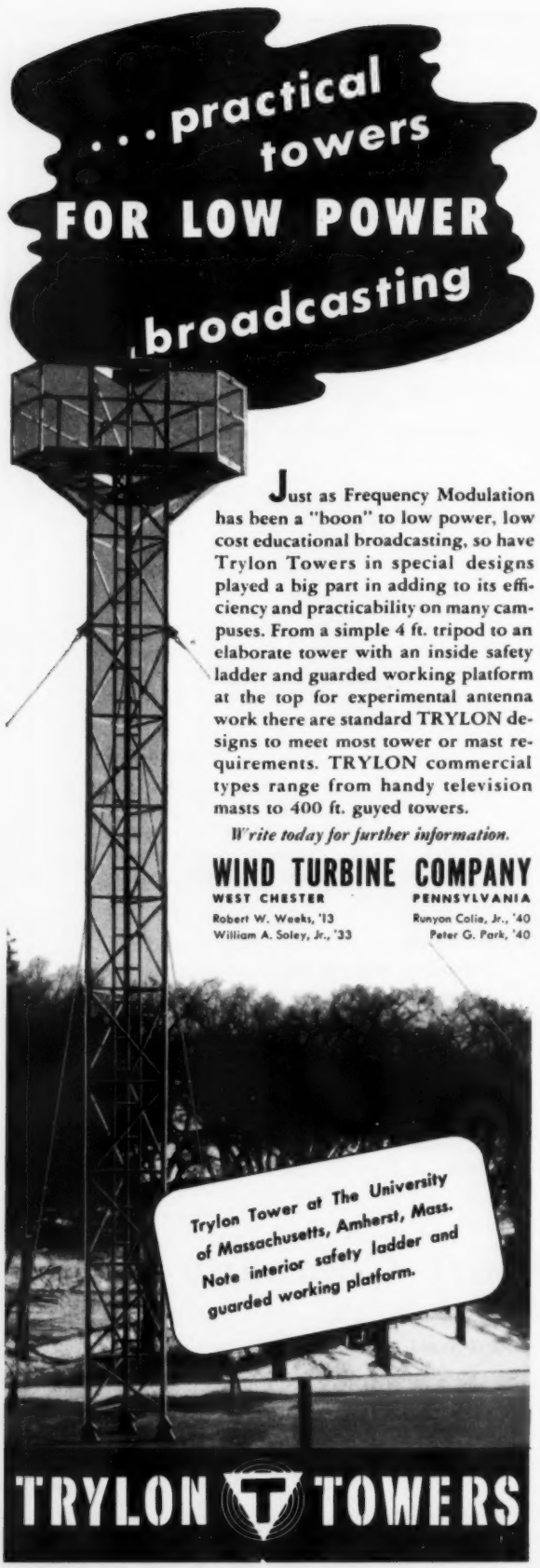
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IS READING OBSOLETE?

(*Concluded from page 542*)

his mind for himself, that's as long as we'll have the only working definition of democracy that's worth a damn.

The second reason for welcoming more competition is that the printed page desperately requires competition. It has only progressed as a result of competition, even though technically it has lagged. We do not have good paper at cheap prices; our presses are fine to look at but why does one need 500 tons of steel to put a dot on a piece of paper? The economics of distribution in the book field are antiquated. It costs $0.60 to produce a book which you can't sell profitably for less than $4.00. The newspapers and many magazines look just about the way they did 20 or 30 years ago except that the ink comes off on your hands more readily. And many of the editors in this nation have failed to accept new ideas. It was only eight years ago that the great New York *Times*, with great reluctance, started to print photographs on the front page.

The phrase that appears most often in printed matter is "We are living in times of change." Perhaps the only trouble with those of us in the publishing business is that we are the last to recognize the need for change.

THE PROMISE OF TECHNOLOGY

(*Continued from page 524*)

warrant the development of the required plastic and several new automatic machines to put the books together.

Besides making it possible to achieve the desired objective, the change opens the way for another important step for simplification and labor saving. It makes possible the development of a new type of high-speed printing press, employing a variable length belt instead of a fixed plate cylinder, which can print and collate the pages of an entire book and deliver them as a unit directly to the binder, thus providing full flexibility of numbers and size of pages. The savings are evident for we can thus eliminate entirely the cumbersome and arduous procedure of folding, storing, and gathering of signatures. The experimental work in this project has been completed, and the next major step in reduction of effort in book production is not far off.

If time permitted, it would be of interest to describe the necessary systematic survey and research which defined the individual problems to be solved to arrive at the new procedure, and which led to the development of a satisfactory flexible rubber plate, new adhesives, new equipment for casing-in, jacketing, and cartoning.

Briefly casting our eyes to other phases of the printing industry for examples, it is not too difficult to find anachronisms in plants which might be considered modern by today's standards, and where the more general application of technology can create vast improvement. For instance, in the printing of the newspaper today, we witness a spectacle of an efficient

(*Continued on page 546*)

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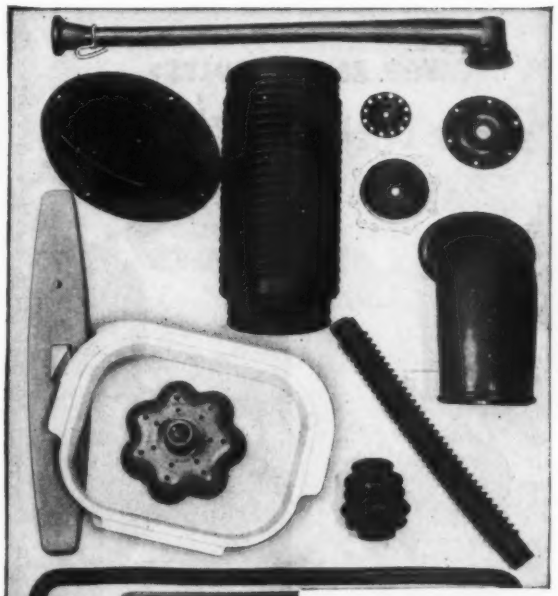

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THE PROMISE OF TECHNOLOGY

(*Continued from page 544*)

high-speed mechanism which will print and fold newspapers at amazing speed, and yet when these newspapers are delivered from the press, on conveyers to the mailing department, they are counted and stacked by hand into miscellaneous bundles for distribution.

To fully capitalize on the tremendous technical advance which has resulted in the high-speed press itself, it would be only logical to expect that the newspapers should be prepared for delivery by some automatic means. We know that can be done, and that it is possible not only to stack and package mechanically, but to mechanize the whole system of handling subscription lists with electronic devices, to control addressing and packaging, and the placing of the correct number of newspapers in each package. The reduction of over-all manufacturing costs, made possible by addition of such a mechanism, would be far greater than that attainable by further development of the printing press alone, and would improve service to the public accordingly.

In another direction we observe the great need for improving methods and equipment to reduce the cost of composition and to make short runs possible. Such a development is of vital importance to all forms of publishing, for it would not only lessen direct costs, but its influence would probably do more to bring out original thoughts than any other single improvement. Today the cost of composition and the making of plates is high, and the only way by which the unit cost can be kept down is by producing the same printed matter in large quantities. Such conditions constitute a formidable barrier to the acceptance, for publication, of the work of the young untried author, who may turn out to be a best seller some day; by the same token, they are hardly conducive to originality on the part of the editorial staff. Perhaps the solution lies in the direction of photocomposition and plastic plates – perhaps by other means, but one way or another a solution is necessary and certainly possible.

The consideration of raw materials now coming into existence also offers important opportunities. The production of a new type of bleached ground wood paper points to the possibility of a substantial reduction in the basic cost of printed matter. Quick-drying plastic base inks can substantially reduce the processing time and the size of printing machinery. New adhesives, which can be formulated to meet almost any needs, can greatly facilitate the manufacture of books and enhance their quality.

The reading of books has greatly increased since the termination of World War II and, likewise, the construction of new homes. It is not impossible that this combination may produce a tremendous market for the hard-cover book to fill new book cases if we can reduce the cost of such printed matter.

The applied research to develop new manufacturing processes and equipment should not be considered to be in the same category as the basic research required to determine trend and the logical objectives for the industry as a whole as far as sponsorship

(*Concluded on page 548*)

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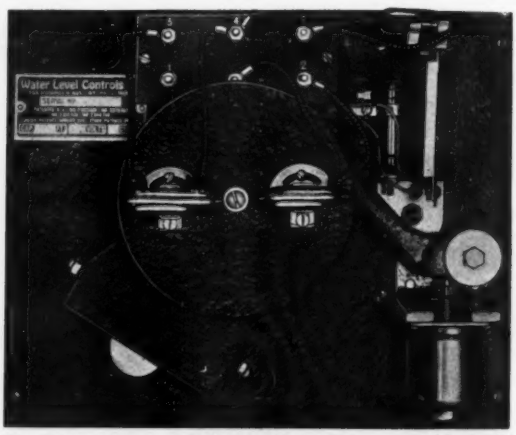

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THE PROMISE OF TECHNOLOGY

(*Concluded from page 546*)

is concerned. The direct beneficiaries of such work are individual concerns, either manufacturers of printed matter, or builders of machines. There is the opportunity of proprietary return from invention and direct benefit from the reduction of manufacturing costs. It would be logical, therefore, to expect individual firms to provide this support. The question remains – will it be forthcoming when needed? The interest of machinery builders is naturally to continue the line of machines already in production, while printing concerns tend to stretch the life of their equipment sometimes far beyond the point of utility. It is not difficult to find opportunities for the development of equipment which can produce high returns in terms of immediate savings. Failure to take action seems to stem more from a lack of perspective than lack of opportunity. Perhaps a stimulus to progress, in this phase of technological development, can be found in the utilization of independent research and engineering organizations which can be called in to analyze and solve specific problems on a project basis. Thus, neither the manufacturer nor the machine builder would be required to maintain a permanent research staff, but could transfer the burden to outside organizations specifically equipped for work of this type.

In my remarks today, I have stressed the need for intelligent systematic research as a guide to technological development. In closing, I should not neglect to point out the need for quality in research, to safeguard the funds which must be devoted to this work. The failure of mediocre thinking to bring about useful results or, paradoxically, the success of ill-chosen costly developments, which bring little economic benefit, is discouraging and sometimes ruinous.

In comparison with the development of other younger industries, such as motion pictures, radio, and the like, development of the graphic arts industry has lagged behind. Perhaps because of its heretofore unchallenged influence on the affairs of man. Perhaps because its age-old traditions stifled or discouraged adventure. Whatever the reason may be, it is not a good one, for the road to future progress lies wide open to those who have the vision and will to employ the consummate technical skill and amazing tools we can command. Technology will never fail to bring us what we have the wisdom to ask for and the courage to pursue. Therein lies its promise.

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OUR SHARED CONVICTIONS

(*Concluded from page 505*)

You have learned to use your imagination as well as your experience, your experiments and your books, in seeking solutions to problems. You have learned the joys of looking ahead, the importance of professional judgment, and of thinking in terms of the future. You have learned the joys of doing a hard job well.

We who continue here have gained from working with you and have cherished the opportunity of sharing with you the responsibilities of this community of scholars. As you take your place as active, producing, creative citizens of America, you have a mandate as educated men and women – you of the mid-century class – to live the American credo if you want the American credo to live. By your actions you can demonstrate as no words can do that American democracy does live and will live – proud and impregnable. You will serve this country best by going forward with confidence in our goals and our mission, remembering that always, as Lowell said of America,

"They love her best, who to themselves are true,
And what they dare to dream of, dare to do."

In the confidence that these shared convictions are shared by you, I wish you the satisfactions of a life of ideal aims and practical accomplishment, and bid you Godspeed.

PRINTING—MOTHER OF PROGRESS

(*Continued from page 509*)

wherein today much or all of the work still is being done by hand labor. The trend is definitely apparent today in the larger and more progressive establishments. Time does not permit of listing and describing some of the quite remarkable and truly revolutionary improvements already evident in many establishments, or on the drawing board, or under prototype production. It is certain that, generally speaking, the actual costs of graphic arts production, regardless of type of product, are not headed for lower levels, by themselves alone. It is evident that the first result of this awakened interest in rapid technological improvement can serve primarily to offset the increasing labor costs of production thus far encountered; after that salutary result is assured, then we may look for efforts and results in the stabilization of long-range

(*Continued on page 552*)

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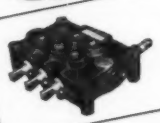

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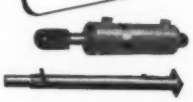

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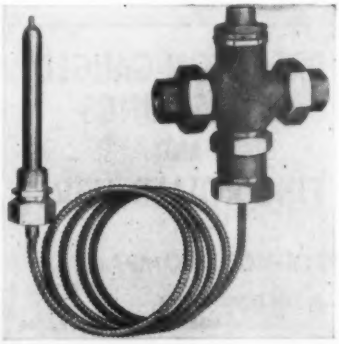

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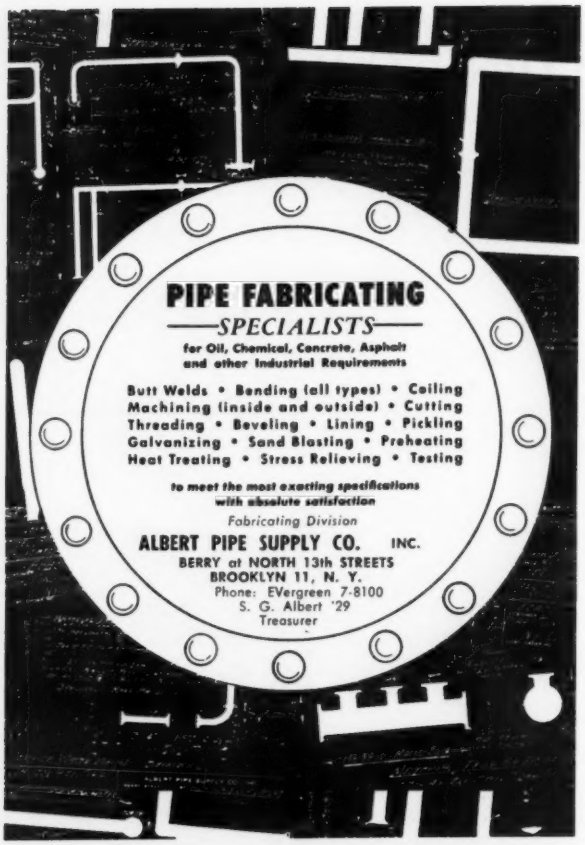
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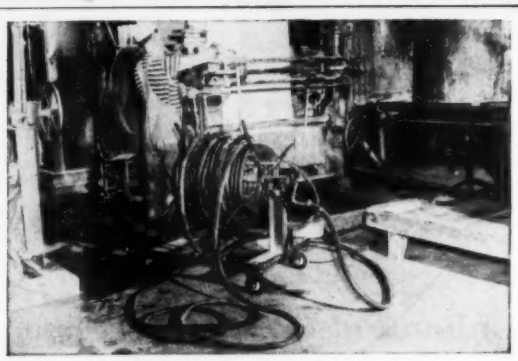

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PRINTING—MOTHER OF PROGRESS

(*Continued from page 550*)

planning and consequent less fluctuating costs in manufacturing.

One hears daily the plaint of book publishers, for example, that the veritable top in pricing levels has been reached in all avenues of book publishing: concern is daily evinced that the continuing top volume of sales, so essential to maintain "a better than break-even operation" for both publisher and manufacturer cannot be maintained if costs are to push individual unit sales prices any higher. One book publisher is experimenting with publishing simultaneously two editions of the same title – one at the popular $1.00 price, the other at the usual $3.50 level. Strangely enough, the rumors observed to date indicate that this sales policy has not lowered the sales of the higher priced book, at the same time providing a tremendously increased sale of the popular priced edition, which certainly is profitable to the publisher. Is this an evidence of a trend that will be expanded to other publishers? The publishers themselves will need to answer that question.

It is a known fact that the publishers of books in the smaller editions are hard hit by present manufacturing cost levels. One publisher has been credited with the statement that, for the average trade book selling in the $2.50 range, the old rule that a minimum first edition sale of 5,000 copies would put the publisher "in the clear," must today be changed to cover a first edition of not less than 10,000 copies. The university presses and the limited edition publishers of technical and quite specialized lines are probably most concerned by the current initial costs of book publication. One hears much of the necessity for publishing more and better-made books.

Much conjecture is heard respecting the probable effect of television on the buying interest of the book-reading public. It will be remembered that the same fears were rampant when automobiles first became available in the popular priced ranges. Similar worries were expressed when radio and the talkie movie first appeared. More recently, in the educational text field, concern was shown over the growth of the visual-aid methods undergoing exploratory tests in that field. Educators have even made surveys and criticized the parents in whose homes television sets were enjoyed – demonstrating that the sons and daughters of such homes were notably the poorest students in their classes. Admittedly, youngsters could study and listen

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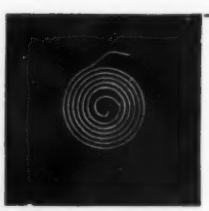

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PRINTING—MOTHER OF PROGRESS

(*Concluded from page 552*)

to the radio at the same time; probably you did it, too. But endeavoring to study and follow the television screen at the same time is a different problem, to be sure!

Notwithstanding, up through the years, every form of communication and education has steadily advanced in volume and generally in quality. When the reported army of war babies hits the elementary schools of our nation in 1954–1955 we will all share the opportunity and responsibility of providing schools, teachers, textbooks, supplies, and the many other needs of that top-volume of students.

Newspapers, periodicals, books, pamphlets, and every form of the printed and otherwise reproduced word have moved forward with all other activities. I am constrained to believe that they will continue their advance, equal to or better than some of the competitive offerings.

Nevertheless, believing that I know more about the graphic-arts industry, and especially the field of bookmaking, than any other industrial activity, I do offer this admonition to those in our field: we must make new and greater effort in the fields of research, invention, and technological problems inherent to our field. To become complaisant, self-satisfied, or unwilling to work, both individually and collectively, with other manufacturers in our industry for the "holding of the line" in cost-upward spirals, through genuine accomplishment in technological engineering, will doom us to destruction as an industry.

Truly, printing has been the "Mother of Progress," and it must continue to be both that "Mother" but, at the same time, the "handmaiden of technological development" in a great and most essential industry. In the memorable words of one of our British cousins:

"It will take the everlasting team-work of every bloomin' soul."

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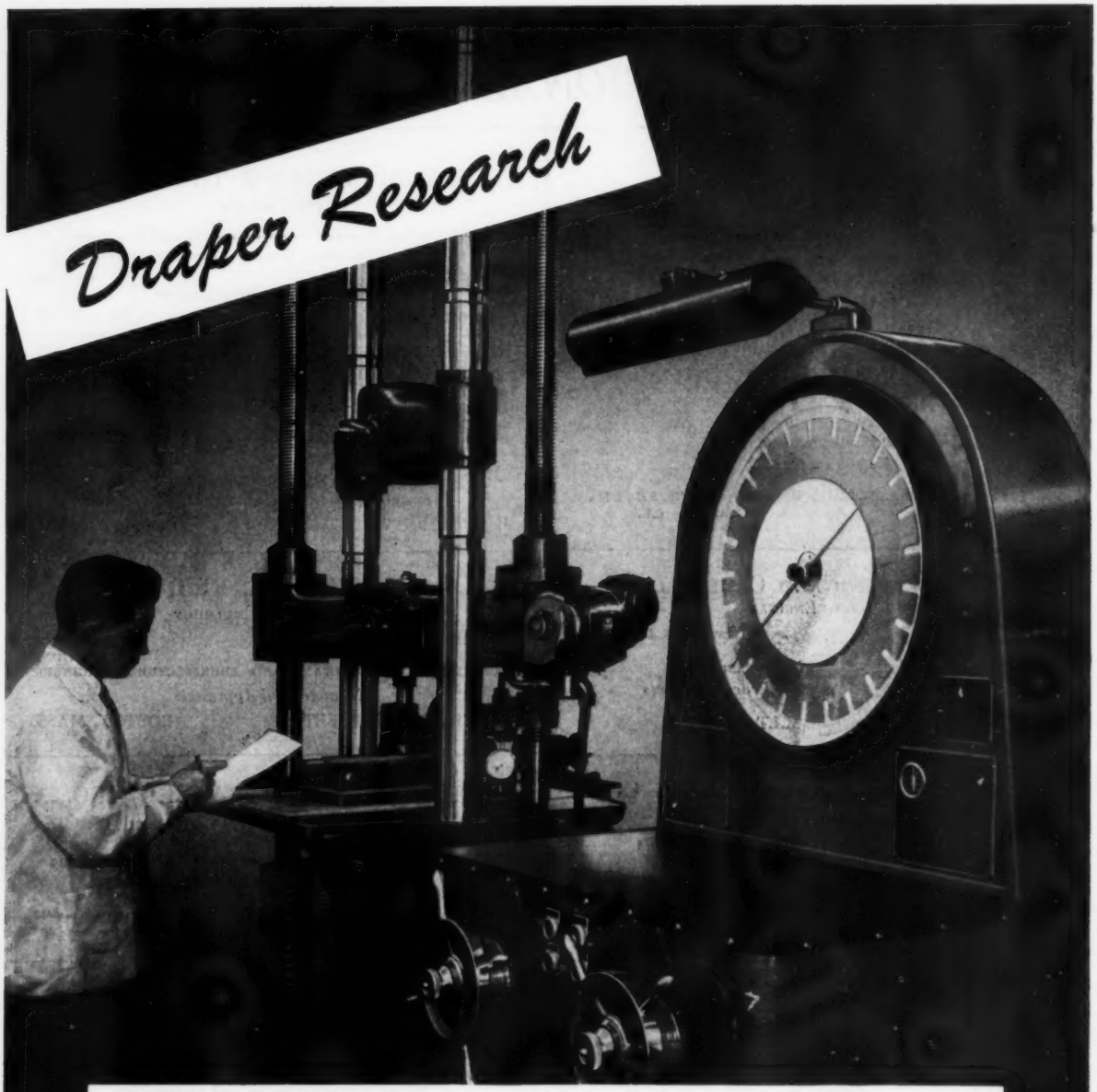

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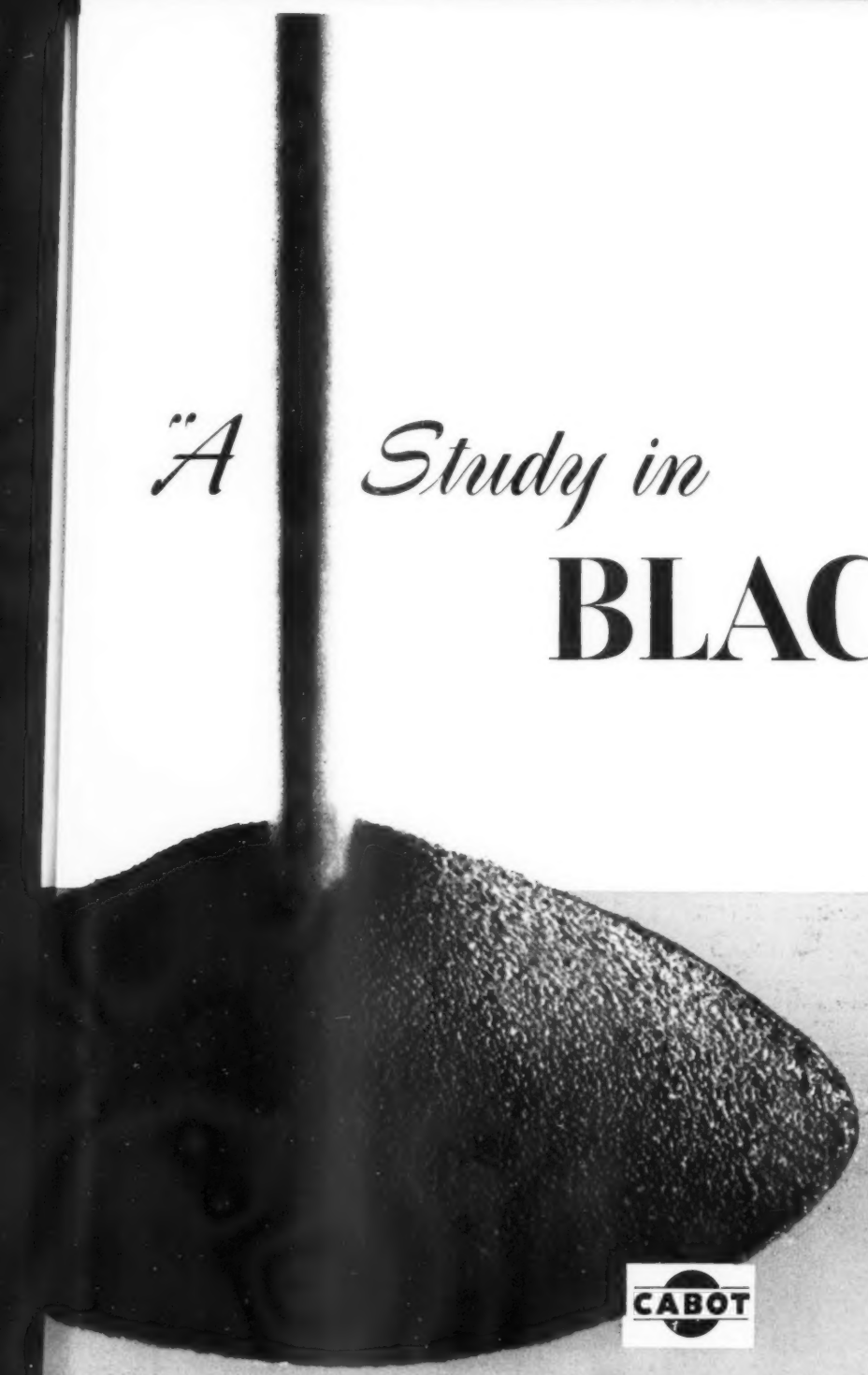

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